Readers might well ask why we’ve included a skills workshop in HVAC&R Nation on maintenance of essential fire safety systems. What is it that HVAC systems do to extinguish or even control fire in a building?

The answer is, very little. They can’t put out fires or even warn the fire brigade, but HVAC systems can make a significant contribution to life safety during fires in buildings, by:

- Preventing spread of fire and smoke  
  — Fire and smoke dampers
- Controlling the spread of smoke between floors  
  — Zoned smoke control systems
- Exhausting heat and smoke generated by fires  
  — Smoke and heat vents in roofs
- Removing toxic smoke from occupied shopping malls  
  — Smoke exhaust fans
- Preventing smoke entering escape paths  
  — Stair pressurisation systems

But are these special HVAC systems really necessary? There aren’t many fires in large buildings: commercial offices, hotels, apartments, hospitals, schools, shopping centres or auditoriums. And, as there are so few fires these systems hardly ever run, so there can’t be much need to maintain them because they won’t wear out.

Well, part of that is right, there aren’t many fires in large buildings — but on those few occasions when a serious fire occurs, the number of people in the building and the hazard created by the spread of toxic and obscuring smoke means there is the risk of major loss of life.

In October 2003 in Chicago, a fire on the 12th floor of a major office building killed six people and 13 more went to hospital. All were found by the rescue team between the 16th and 22nd floors.

During a fire in the NSW Bowlers Club, September 1994, office workers on the 12th Floor could not escape because smoke prevented them finding the fire stair door.

In these fires, and others, the deaths were caused by the spread of toxic smoke, which also obscured escape paths. This is why building legislation in all Australian states and territories requires new and refurbished buildings to have specific smoke control systems. And, to get to the point of this article, Australian states and territories have regulations (all different!) that require maintenance of essential fire safety systems plus annual certification of the performance of essential fire safety systems.

**What is maintenance of essential fire safety systems?**

Maintenance covers the tasks necessary for fire safety systems or equipment to reliably achieve their fire safety duty (performance) and continue to do so until the next maintenance activity.

The Australian Standard on Maintenance of Fire Protection Systems and Equipment, AS 1851 2005 classifies “Maintenance” into four basic tasks, roughly described below:

**Inspection:** Visual examination to show correct setting, condition or fitness for purpose.

**Test:** Confirms correct function or performance of an item or system.

**Maintenance:** The work of lubrication, cleaning, adjustment and routine replacement of parts, to avoid breakdown. (Often called preventive maintenance)

**Survey:** Visual inspection to see if systems have been altered or damaged.

Table 1 (below) indicates what is achieved by each of these maintenance tasks.

**What maintenance is NOT**

Maintenance is NOT the final completion of construction and installation, and maintenance is NOT a substitute for commissioning.

<table>
<thead>
<tr>
<th>Maintenance task</th>
<th>Inspection</th>
<th>Test</th>
<th>Preventive maintenance</th>
<th>Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirms correct status visually</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confirms correct function and performance</td>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimises incidence of breakdown</td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Identifies system is not altered, damaged or compromised</td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 1
Why use Australian Standard AS 1851-2005?

- State laws require maintenance of fire safety measures in buildings.
- State legislation (generally) requires annual certification that fire safety measures can perform to the correct standard.

In some states, regulations nominate specific maintenance standards or specifications, but in other states, there is no prescribed standard so the Australian Standard – Maintenance of Fire Protection Systems and Equipment, AS 1851-2005 may be considered a reasonable legal basis for planning and executing maintenance. Check this with your lawyer!


AS 1851-2005 specifies maintenance requirements for all fire protection systems and equipment. Its objectives and general administrative parts are in Section 1. The next 18 sections cover the main fire protection systems. HVAC fire and smoke control systems are in Section 18.

Don’t make the mistake of avoiding Section 1. Scope and General, in AS 1851. Section 1 explains how the Standard and contains 25 tables!

Section 18 of the Standard – Fire and smoke control features of HVAC systems

The first clause in this Section, 18.1, makes it clear that the Standard does not apply to systems used for comfort cooling, heating or ventilation that don’t operate in fire mode. However, systems required to shut down on fire alarm, must be proved to shut down.

Clause 18.2 contains the documentation requirements, including examples. This clause also explains the difference between fire safety equipment used in day-to-day operation and fire safety equipment that is dedicated to fire duty only.

Clause 18.4 is where the inspection, test, maintenance and survey tasks are scheduled. This takes 28 pages of the Standard and contains 25 tables!

Seventeen tables specify inspection and maintenance (preventive maintenance). Five tables specify testing procedures and three tables specify survey activities.

There are no shortcuts here! If you are doing maintenance, testing, annual certification or surveys of fire and smoke control features of HVAC systems in a client’s building, you must read and understand all of the tables applying to the systems and equipment in that building.

What are the HVAC fire protection equipment and systems covered by AS 1851-2005?

- Fire and smoke dampers
- Exit pressurisation systems
- Mechanical air handling systems
  - Zone smoke control
  - Shutdown of non-essential plant
- Smoke exhaust fans or systems
- Smoke and heat vents, including smoke curtains
- Carpark exhaust systems
- Kitchen hood exhaust systems

These are the fire protection equipment or systems specified in state and territory building regulations. Fire and smoke dampers are simple, but the rest are often quite complicated systems, with large numbers of components: dampers, actuators, motors, controllers, fans, etc.

### TABLE 18.4.1.1 — INSPECTION, PREVENTIVE MAINTENANCE AND RECORDS SCHEDULE • FIRE AND SMOKE CONTROL FEATURES OF HVAC SYSTEMS • FANS AND MOTORS • SUPPLY, EXHAUST SPILL OR RETURN AIR • USED IN DAY-TO-DAY OPERATION

<table>
<thead>
<tr>
<th>Item No</th>
<th>Item</th>
<th>Action required &amp; Pass/fail requirement</th>
<th>Frequency</th>
<th>Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Obstructions</td>
<td>CHECK there are no physical obstructions likely to impede performance.</td>
<td>Monthly</td>
<td>...</td>
</tr>
<tr>
<td>1.2</td>
<td>Noise, overheating and vibration</td>
<td>CHECK motor and all bearings for noise, overheating and excessive vibration.</td>
<td>Quarterly</td>
<td>...</td>
</tr>
<tr>
<td>1.3</td>
<td>Flexible connections</td>
<td>CHECK flexible connections, where fitted, for leaks, tearing or fraying.</td>
<td>Six-monthly</td>
<td>...</td>
</tr>
<tr>
<td>1.4</td>
<td>Fan belts – wear</td>
<td>CHECK fan belts for wear.</td>
<td>Yearly</td>
<td>...</td>
</tr>
<tr>
<td>1.5</td>
<td>Guards and other safety features</td>
<td>CHECK for satisfactory condition.</td>
<td>Five-yearly</td>
<td>...</td>
</tr>
<tr>
<td>1.6</td>
<td>Bearings</td>
<td>CHECK lubrication of bearings.</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>1.7</td>
<td>Couplings</td>
<td>CHECK couplings for tightness.</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>1.8</td>
<td>Fan belts – tension</td>
<td>CHECK for correct tension.</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>1.9</td>
<td>Pulley wheels and couplings</td>
<td>CHECK pulley wheels and couplings for alignment.</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>1.10</td>
<td>Casing, guards and impeller</td>
<td>CHECK casing, guards and impeller for corrosion.</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>1.11</td>
<td>Electrical</td>
<td>CHECK electrical connections, isolators and terminal box.</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

NOTE: Diagnostic procedures or remote monitoring are an acceptable alternative to sensory inspection such as sight, touch, hearing or smell. This alternative is particularly applicable where sensory inspection is dangerous or not practicable.
What are the actual ‘things’ that must be inspected, tested, maintained and surveyed?

The Standard has 17 tables for inspection and preventive maintenance of equipment and components. These are:
- Fans and motors used in day-to-day operation and fire mode
- Fans and motors dedicated to fire mode duty only
- Fire dampers (including intumescent dampers)
- Smoke dampers
- Air control dampers (with only one fire mode operation)
- Air control dampers (with two fire modes)
- Automatic smoke and heat vents
- Smoke curtains
- Motorised relief openings
- Electric heaters; Kitchen exhaust systems
- Outdoor air intakes
- Variable frequency drives
- Pneumatic compressors
- Motor control centres
- Power supplies (main switchboards)
- Fire fan control panels and fire indicator panels.

The Standard has five tables for testing of each system. These are:
- Fire isolated exit pressurisation systems
- System changeover under fire condition
- Smoke exhaust systems
- System shutdown
- Smoke dampers

The Standard has three tables for design and installation surveys of: Active fire and smoke control systems; motorised relief openings and smoke reservoirs.

Special features of Section 18 of AS 1851-2005

Complex systems need documentation

Air conditioning and mechanical ventilation systems in large buildings have many components. They often have vari-speed drives and electronic controls for fire alarm operation. The sheer number of components makes these systems very complex. Some of these have single-role fire safety duty, like stair pressurisation fans and smoke exhaust dampers. Some simply shut down or adopt a fail-safe mode in fire alarm. Whatever the mode, dedicated operation or fail-safe, the critical issue is correct operation of every component, to control smoke and protect lives.

Add to this complexity, the fact that major commercial buildings are always undergoing tenancy alterations and refurbishment, involving modifications or additions to existing equipment. With this mix of large numbers of components, variety of operations and regular changes, it is not surprising that:
- Smoke control systems can be very complex,
- They change from one year to the next, and
- With large numbers of components, there will be frequent faults in the system as a whole.

Fire alarm performance cannot be verified each year without accurate, up-to-date documentation of system operating requirements. The Standard includes an excellent system functionality test chart with notes on its application.

Fire dampers

Maintenance is not repair of bad installations

Fire dampers are very simple devices, needing minimal maintenance. But the industry suffers from poor installation of fire dampers, so the distinction between ongoing maintenance and repair of installation defects has become blurred. Maintenance is not intended to repair bad installations. Maintenance is not a substitute for installation checks and commissioning.

When installation defects are found during maintenance inspections, tell the building owner that these essential fire safety measures are not capable of protecting the building as required. At that stage, repair of installation defects for all fire dampers in the building must be completed before proceeding with maintenance under the Standard. It should be clear that maintenance inspections for fire dampers are not meant to be audits of the original installation quality. Installation defects should be a trigger for separate, additional inspections and such inspections may involve removal of flanges and other invasive work.

Surveys

A survey is conducted visually from floor level or by observation through vent and fan discharges. It is intended to identify changes to the HVAC system or the building that would affect the performance of the smoke control features. This is a new field for the HVAC maintenance industry, and may require specialised contractors.

Need for skilled practitioners

The inspection and maintenance tables in Section 18 rarely specify particular maintenance tasks. The Standard notes that it relies on the judgement or skill of qualified technicians who will replace, adjust or repair when the need for such work is revealed during an inspection. Hence, the Standard relies on the judgement and skill of qualified technicians. Section 18 of the Standard recommends three skill levels for personnel carrying out maintenance.

Motor control centres, main switchboards and fire panels

AS 1851-2005 nominates maintenance requirements for motor control centres, main switchboards, fire fan control panels and fire indicator panels. These provide electrical power and control for HVAC fire and smoke control equipment as well as other electrically driven fire safety equipment, so they must be maintained to ensure reliability.

Some HVAC contractors and fire safety contractors are concerned that these tables are found in Section 18. Isn’t this section for HVAC fire and smoke control systems only?

These tables are in Section 18, only so that all switchboard and control panel maintenance is included in the same part of the Standard. It is not the intention that this work should be carried out only by HVAC technicians or only by fire detection and alarm technicians. Maintenance of fire protection systems and equipment must be conducted by competent persons.

NOTE: It is likely that in the next update of the Standard, the location of switchboard maintenance tables will be relocated, and frequency of inspection and maintenance for fans and dampers will change.

This month’s skills workshop is written by Simon Hill of Professional Engineering Solutions. Simon, in conjunction with AIRAH, developed the course material and delivers the face-to-face version of AIRAH’s essential safety measures course. For more information on the recently released distance learning course on essential safety measures for technicians, turn to page 19.

Next Month’s Workshop — Essential services maintenance – part 2