Health Technical Memorandum 03-01: Specialised ventilation for healthcare premises

Part B The management, operation, maintenance and routine testing of existing healthcare ventilation systems

Draft for technical engagement
December 2019
# Contents

## 1 INTRODUCTION

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Preamble</td>
<td>5</td>
</tr>
<tr>
<td>1.2 Ventilation in Healthcare Premises</td>
<td>5</td>
</tr>
<tr>
<td>1.3 Statutory Requirements</td>
<td>5</td>
</tr>
<tr>
<td>1.4 Codes of Practice and Guidance</td>
<td>7</td>
</tr>
<tr>
<td>1.5 Management Responsibilities – General</td>
<td>8</td>
</tr>
<tr>
<td>1.6 Lifecycle of Ventilation Systems</td>
<td>10</td>
</tr>
</tbody>
</table>

## 2 FUNCTIONAL RESPONSIBILITIES

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Management Responsibilities</td>
<td>12</td>
</tr>
<tr>
<td>2.2 Designated Staff Functions</td>
<td>12</td>
</tr>
<tr>
<td>2.3 Risk Assessment – Routine Inspection and Maintenance</td>
<td>15</td>
</tr>
<tr>
<td>2.4 Specific Health and Safety Aspects</td>
<td>15</td>
</tr>
</tbody>
</table>

## 3 VENTILATION SYSTEMS – MINIMUM STANDARDS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 General Requirements</td>
<td>16</td>
</tr>
<tr>
<td>3.2 Location and Access</td>
<td>16</td>
</tr>
<tr>
<td>3.3 Basic Requirements</td>
<td>17</td>
</tr>
<tr>
<td>3.4 AHU Intakes and Discharges</td>
<td>18</td>
</tr>
<tr>
<td>3.5 Plant Drainage System</td>
<td>18</td>
</tr>
<tr>
<td>3.6 Dampers</td>
<td>19</td>
</tr>
<tr>
<td>3.7 Fans and Their Drives</td>
<td>19</td>
</tr>
<tr>
<td>3.8 Heaters–Batteries</td>
<td>20</td>
</tr>
<tr>
<td>3.9 Humidifiers</td>
<td>20</td>
</tr>
<tr>
<td>3.10 Filtration</td>
<td>21</td>
</tr>
<tr>
<td>3.11 High-Efficiency Particulate Filters – HEPA</td>
<td>21</td>
</tr>
<tr>
<td>3.12 Energy Recovery</td>
<td>22</td>
</tr>
<tr>
<td>3.13 Attenuation</td>
<td>22</td>
</tr>
<tr>
<td>3.14 Identification and Labelling</td>
<td>22</td>
</tr>
<tr>
<td>3.15 Pressure Stabilisers</td>
<td>22</td>
</tr>
<tr>
<td>3.16 Chilled Beams – Active and Passive Types</td>
<td>23</td>
</tr>
<tr>
<td>3.17 Fan Coil Units</td>
<td>23</td>
</tr>
<tr>
<td>3.18 Portable Air Conditioners</td>
<td>23</td>
</tr>
<tr>
<td>3.19 Portable Filter Units</td>
<td>23</td>
</tr>
<tr>
<td>3.20 Low-Level Extracts</td>
<td>23</td>
</tr>
<tr>
<td>3.21 Fire and Smoke Dampers</td>
<td>23</td>
</tr>
<tr>
<td>3.22 Control Panels</td>
<td>23</td>
</tr>
<tr>
<td>3.23 Theatre, Imaging and Treatment Room Panels</td>
<td>24</td>
</tr>
</tbody>
</table>
ENERGY EFFICIENCY

4 ANNUAL INSPECTION AND VERIFICATION REQUIREMENTS

VENTILATION SYSTEMS INSPECTION
CRITICAL VENTILATION SYSTEMS
DEFINITION OF A CRITICAL SYSTEM
ANNUAL VERIFICATION
FABRIC OF THE AREA SERVED
CRITICAL VENTILATION SYSTEMS — VERIFICATION STANDARDS
CRITICAL SYSTEM VERIFICATION FAILURE

5 ROUTINE INSPECTION AND MAINTENANCE

GENERAL
INSPECTION AND MAINTENANCE OF CRITICAL SYSTEMS
AHU ROUTINE INSPECTION
AHU DRAINAGE
FILTER CHANGING
CHANGING EXTRACT FILTERS CONTAINING HAZARDOUS SUBSTANCES
AIR TERMINALS
UCV CANOPIES
PRESSURE STABILISERS
TRANSFER GRILLES
VENTILATION SYSTEM CLEANING
CHILLED BEAMS — ACTIVE AND PASSIVE TYPES
SPLIT AND CASSETTE AIR-CONDITIONING UNITS
FAN COIL UNITS
PORTABLE ROOM AIR-CONDITIONING UNITS
SELF-CONTAINED MOBILE FILTER AND/OR ULTRAVIOLET (UV) LIGHT UNITS
INSPECTION AND MAINTENANCE RECORDS

APPENDIX 1 — ANNUAL INSPECTION OF CRITICAL VENTILATION SYSTEMS — AHU AND PLANTROOM EQUIPMENT

APPENDIX 2 — OPERATING SUITE ANNUAL VERIFICATION

APPENDIX 3 - EQUIPMENT RELEASE CERTIFICATE

APPENDIX 4
Executive summary

Preamble

Health Technical Memorandum 03-01 – ‘Specialised ventilation in healthcare premises’ is published in two parts: Part A deals with the design and installation of ventilation systems; Part B covers operational management.

The document gives comprehensive advice and guidance on the legal requirements, design implications, maintenance and operation of specialised ventilation in healthcare premises providing acute care. The use of these premises is very intense, the occupancy level high and the patients may be particularly susceptible to airborne infection risks. Their condition may also require close control of the environment.

The ventilation of non-healthcare facilities within the hospital curtilage should be designed to suit the application; and specific guidance relating to the activity should be followed (e.g. pharmacy (HBN 14-01), sterile services departments (HBN 13), etc). However, as they are on the hospital site, the means of providing ventilation should not adversely impact upon the hospital; e.g. evaporative cooling towers should not be installed, sound levels should be appropriate and if the facility is within or attached to an area accessed by patients, their needs and the risk of airborne contamination should be considered.

In other types of healthcare facility that are outside of the hospital curtilage (e.g. GP practices, health centres, minor injuries units, dental, ophthalmic & podiatry clinics, mental health facilities, respite care, long-stay care homes and hospices), a risk assessment of the nature of the treatment being delivered, condition of the patients and intensity of use needs to be undertaken in order to determine the extent to which this guidance will be applicable.

The guidance contained in Part A of this Health Technical Memorandum applies to new installations and major refurbishments of existing installations.

The guidance contained in Part B of this Health Technical Memorandum applies to all ventilation systems installed in healthcare premises irrespective of the age of the installation.

1 Introduction

Preamble

1.1 Health Technical Memorandum 03-01 – ‘Specialised ventilation in healthcare premises’ is published in two parts: Part A deals with the concept, design, specification, installation and acceptance testing of ventilation systems; Part B covers the management, operation, maintenance and routine testing of existing healthcare ventilation systems.

1.2 The document gives advice and guidance to healthcare management, design engineers, estates managers and operations managers on the legal requirements, design implications, maintenance and operation of specialised ventilation in all types of healthcare premises.

1.3 The guidance contained in Part B of this Health Technical Memorandum applies to all ventilation systems installed in healthcare premises irrespective of the age of the installation.

1.4 This revision of Health Technical Memorandum 03-01 supersedes the 2007 version of Health Technical Memorandum 03-01.

Ventilation in healthcare premises

1.5 Ventilation is used extensively in all types of healthcare premises to provide a safe and comfortable environment for patients and staff. It is provided to help control airborne infection risks in areas such as operating departments, critical care facilities, isolation rooms and treatment areas.

1.6 It may also be installed:

- to ensure compliance with the quality assurance requirements of items processed in pharmacies and sterile services departments;
- to protect staff from harmful organisms or toxic substances (e.g. in laboratories and anaesthetic rooms);
- to contain the spread of, and clear, smoke as part of the fire strategy.

Statutory requirements

1.7 The Health Act places a duty of care on healthcare providers. Increased health risks to patients will occur if ventilation systems do not achieve and maintain the required standards. The link between surgical site infection and theatre air quality has been well-established. If the ventilation plant has been installed to dilute or contain harmful substances, its failure may expose people to unacceptable levels of contamination. Breaches of the statutory requirements can result in prosecution and may also give rise to a civil suit against the operators.

Health and Safety at Work etc. Act 1974

1.8 The Health and Safety at Work etc. Act 1974 is the core legislation that applies to ventilation installations. As these installations are intended to prevent contamination,
closely control the environment, dilute contaminants or contain hazards, their very
presence indicates that potential risks to health have been identified.

COSHH
1.9 The Control of Substances Hazardous to Health (COSHH) Regulations 2002 (as
amended) place upon management an obligation to ensure that suitable measures are
in place to protect their staff and others affected by the work activity. These methods
may include both safe systems of work and the provision of a specialised ventilation
system. In laboratories the requirements are often met by the provision of fume
cupboards and microbiological safety cabinets.

1.10 Where specialised ventilation plant is provided as part of the protection measures,
there is a statutory requirement that it be correctly designed, installed, commissioned,
operated and maintained. The Local Exhaust Ventilation (LEV) section of COSHH
requires that the system be examined and tested at least once every 14 months by a
competent person (P601 certified) and that management maintain comprehensive
records of its performance, repair and maintenance.

1.11 Certain substances have workplace exposure limits (WELs) as set out in the Health
and Safety Executive’s Guidance Note EH40 – ‘Workplace exposure limits’. If
specialised ventilation systems are provided in order to achieve these standards, they
will be subject to the COSHH Regulations as above.

Workplace (Health, Safety and Welfare) Regulations
1.12 State that all enclosed workplaces must be ventilated by natural or artificial means.

1.13 Any plant provided under this legislation must include an effective device to give an
audible or visual warning of plant failure where necessary for health and safety.

1.14 The Regulations require that ventilation systems are “maintained in an efficient state,
in efficient working order and in good repair”.

Building Regulations
1.15 Apply to domestic and non-domestic buildings.

1.16 Clarify satisfactory methods of providing ventilation and give ventilation rates.

1.17 Set minimum standards for:

- The protection of the supply position
- Precautions against *Legionella*
- The purity of recirculated air
- Access for service and maintenance
- Documentation and proof of performance

Fire regulations
1.18 The fire regulations require that, if ventilation ductwork penetrates the fabric of a
building, it should be designed and installed to contain the spread of fire and smoke
(see Health Technical Memorandum 05 series for guidance).
1.19 When ventilation systems are originally designed, they will conform to an agreed fire strategy. This will determine the provision of fire-rated ductwork, the siting of fire dampers and an agreed control action for the ventilation fans in the event of a fire.

1.20 It is management’s responsibility to ensure that the fire strategy applied during the design and installation of a system is not reduced during the subsequent operation and maintenance of the equipment.

1.21 If a ventilation system is upgraded or altered to suit a change of use, it will be necessary to reassess the fire strategy.

Plant installed in units manufacturing medicinal products

1.22 Plant installed in units manufacturing medicinal products to the standards set out in the current European guide to good manufacturing practice may also be subject to particular legislation with regard to their operation in addition to that mentioned above.

1.23 There are specific requirements under the Medicines Act 1968 to maintain accurate records of plant performance, room conditions and maintenance events. Such records would need to be preserved for at least 25 years as part of a quality assurance audit trail.

Plant installed in laboratories

1.24 Specialised ventilation plant installed in laboratories dealing with research, development, testing or other specialist applications (this could concern medicinal products, IVF, tissue, animals or genetically modified organisms) may be subject to particular legislation with regard to their operation in addition to that mentioned above.

Codes of practice and guidance

1.25 All ventilation systems should conform to the principles set out in the Health and Safety Executive’s (HSE) Approved Code of Practice and guidance on Regulations; ‘Legionnaires’ disease: the control of Legionella bacteria in water systems’ (commonly known as L8), and Health Technical Memorandum 04-01 – ‘Safe water in healthcare premises’.

1.26 The HSE has published complementary technical guidance in HSG274, which is split into three specific areas:

- Part 1 – evaporative cooling systems;
- Part 2 – hot and cold water systems; and
- Part 3 – other risk systems.

1.27 The Department of Health publication ‘The Health and Social Care Act (2013) Code of Practice on the prevention and control of infections and related guidance’ (the HCAI Code of Practice) is a code of practice that has been brought out to help NHS bodies to plan and implement how they can prevent and control healthcare-associated infections. It sets out criteria by which managers of NHS organisations are to ensure that patients are cared for in a clean environment and where the risk of healthcare-associated infections is kept as low as possible. Specialised ventilation systems often play a significant role in achieving this objective.
Management responsibilities – general

1.28 It is a management responsibility to ensure that inspection, service and maintenance activities are carried out safely without hazard to staff, patients or members of the public.

1.29 Those required to monitor and/or maintain ventilation equipment will need to show that they are competent to do so (see Chapter 2).

1.30 Maintenance procedures should be reviewed periodically to ensure that they remain appropriate.

1.31 The preservation of information and records of ventilation systems and their performance is a legal requirement. It is therefore essential that records are kept in a form that when archived can be accessed when necessary. Keeping records on a dedicated computer drive unit within the estates department while satisfactory for day to day operation is not adequate for archival storage.

1.32 Estates statutory maintenance records must be retained and managed through the healthcare providers’ information governance arrangements. Estates Department must periodically archive their records of statutory and critical systems.

System information

1.33 An inventory of all ventilation systems installed and in use or capable of being used must be kept. The inventory should be readily accessible within the operational section of the estates department in hard copy and electronic form.

1.34 The inventory should be subdivided into the following categories:

- local exhaust ventilation systems (LEV) – note these are statutory items;
- critical healthcare ventilation systems (CHV) (these are systems the loss of which would seriously limit the delivery of healthcare e.g. operating suite, SCBU, ICU, interventional imaging suite, aseptic preparation facilities, etc.);
- general ventilation system (supply and extract) (GVS);
- general extract systems (GES);
- systems installed for smoke clearance in the event of a fire – classed as smoke and heat exhaust ventilation systems (SHEVS) (e.g. smoke extract fans in stairwells, automatic smoke clearance dampers in atria).

1.35 For each ventilation system the inventory should contain the following details:

- a unique system identification code e.g. LEV 001; CHV 001 etc. as appropriate;
- location of the ventilation fan unit or supply and extract AHU(s);
- location of the fresh air inlet;
- location of the extracted air discharge;
- specific area(s) served by the system;
- date the system was installed;
• date the system was first commissioned;
• date of its annual inspection;
• date and details of any significant alterations or replacements made to the system.

1.36 When systems are removed or replaced, their unique identification code should be transferred from the inventory to an archive together with all its records. These should be retained for a minimum of 5 years (See paragraph 1.31 and 1.32 above)

1.37 New or replacement systems should be allocated a new unique identification and added to the inventory.

1.38 Each ventilation system should have a log (physical or electronic) that contains the following information:

• the unique system identification reference;
• purpose of the system;
• date of installation;
• details of the installed equipment and ductwork layout;
• detail of the fire plan and location of fire and smoke dampers;
• design performance parameters e.g. airflow rates, air change rates, pressures, etc;
• commissioned date and performance;
• record of the system validation and original acceptance;
• records of the annual inspection and verification;
• maintenance records and plant information e.g. fan specifications and filter sizes.

1.39 The records should be linked to the inventory and stored in such a way as to be readily available in the event of plant breakdown or other incident.

1.40 When new ventilation systems are accepted for use, full information as to their designed mode of operation together with recommended maintenance procedures should be provided as part of the handover procedure. Part A of this Health Technical Memorandum gives design parameters for new installations.

1.41 Many new installations are designed and stored electronically within a building information management (BIM) programme. It is important to update the BIM model if there are any physical changes made or design parameters modified during the life of the system.

1.42 In existing systems, original design and commissioning information will often not be available. It will be necessary to determine a suitable level of system performance based on the function, purpose and age of the installation. This information should be entered in the system log file and form the baseline for the annual verification.

1.43 Chapter 3 sets out the minimum standards for all air handling units (AHUs) and their air distribution systems irrespective of when they were installed.
1.44 All system records must be kept for at least 5 years. The Health and Safety Executive and other interested bodies such as the Care Quality Commission (CQC) have a statutory right to inspect them at any time. (See paragraph 1.31 above)

**Action in the event of an incident**

1.45 In the event of a reportable incident connected with ventilation equipment or the area that it serves, copies of all records and plant logbooks may need to be collected as evidence. The requirements of the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) will apply.

**Note:** In the event of an incident, while there may be a legal requirement to hand over information and records to the investigator, it is essential that the healthcare provider retains copies as they will be necessary for the continued safe operation and maintenance of the system.

**Frequency of inspections and verifications**

1.46 All ventilation systems must be subject to at least a simple visual inspection annually.

1.47 All CHVs should be inspected quarterly and their performance measured and verified annually. The quarterly inspection should be a simple visual check; the annual verification will be a more detailed inspection of the system together with the measurement of its actual performance.

1.48 A set of specimen maintenance checklists is given in the Appendices.

1.49 The LEV section of the COSHH regulations contains a statutory requirement that systems installed to contain or control hazardous substances be examined and tested at least once every 14 months by a competent person. The statutory inspection and test must be of the complete system from the point of capture to the point of discharge.

1.50 Regular tests, at intervals agreed with the local fire prevention officer [should this say instead “the Fire Safety Manager” in accordance with FireCode?] will need to be carried out in order to demonstrate the continuing efficiency of the fire detection and containment systems. These may be in addition to the inspections detailed above. Records of these tests must be kept.

**Lifecycle of ventilation systems**

1.51 In order to maintain efficiency, ventilation systems should be taken out of use after not more than 10 years of service life. The distribution ductwork should be inspected and cleaned as appropriate, control system upgraded and the entire installation rebalanced, recommissioned and its performance validated. During this process the opportunity should be taken to replace any belt-driven fans with electronically commutated (EC) plug fans or direct-drive plug fans. (Chapter 9 in HTM03-01 Part A gives details of fan types and preferred selection and installation strategies.)

1.52 Whenever a critical area is being refurbished, the condition of the ventilation plant should be reviewed and replaced as necessary.

1.53 Plant should be scheduled for replacement after 20 years. In order to secure funding and programme downtime for the area served, a site-wide plant replacement programme should be in place. As an example, if a site has 40 AHUs then at least two
will need to be replaced every year. The plant replacement should coincide with a refurbishment of the area served.

If the site is a new build with all plant of the same age, then the plant replacement programme should commence after 10 years as it will not be practical to replace all units simultaneously at the 20-year mark.
2 Functional responsibilities

Management responsibilities

2.1 Clear lines of managerial responsibility should be in place so that no doubt exists as to who is responsible for the safe operation and maintenance of the equipment.

2.2 A periodic review of management systems should take place in order to ensure that the agreed standards are being maintained.

2.3 Those required to inspect, verify or maintain ventilation equipment will need to show that they are competent to do so. As a minimum they should have sufficient knowledge of its correct operation to be able to recognise faults.

2.4 Training in the validation and verification of specialised healthcare ventilation systems for Authorised Persons (APs) and Competent Persons (CPs) is available from a variety of providers. While there is a duty on postholders to keep their knowledge up to date as reflected for APs in their CPD record, there is no requirement to routinely attend any specific refresher course.

Designated staff functions

2.5 A person intending to fulfil any of the staff functions specified below should be able to prove that they possess sufficient skills, knowledge and experience to be able to safely perform the designated tasks.

Management (Duty Holder)

2.6 Management is defined as the owner, occupier, employer, general manager, chief executive or other person who is ultimately accountable for the safe operation of premises.

Designated Person

2.7 This person provides the essential senior management link between the organisation and professional support. The Designated Person should also provide an informed position at board level.

Authorising Engineer (Ventilation) (AE(V))

2.8 The AE(V) is defined as a person designated by Management to provide independent auditing and advice on ventilation systems and to review and witness documentation on validation.

Authorised Person (Ventilation) (AP(V))

2.9 The AP(V) will be an individual possessing adequate technical knowledge and having received appropriate training, appointed in writing by the Designated Person (in conjunction with the advice provided by the AE(V)), who is responsible for the practical implementation and operation of Management’s safety policy and procedures relating to the engineering aspects of ventilation systems.
Competent Person (Ventilation) (CP(V))

2.10 The CP(V) is defined as a person designated by Management to carry out maintenance and periodic testing of ventilation systems.

Infection Prevention and Control Officer

2.11 The Infection Prevention and Control (IPC) Officer (or consultant microbiologist if not the same person) is the person nominated by management to advise on monitoring the IPC policy and microbiological performance of the systems [note: para 2.20 mentions the “IPC lead” – which is the correct terminology?].

2.12 Major policy decisions should be made through an IPC committee, which should include representatives of the user department and estates and facilities or their nominated representative (that is, the Authorised Person).

User

2.13 The User is the person responsible for the management of the unit in which the ventilation system is installed (for example head of department, operating theatre manager, laboratory manager, production pharmacist, head of research or other responsible person).

Contractor

2.14 The Contractor is the person or organisation responsible for the supply of the ventilation equipment, its installation, commissioning, validation, verification or decommissioning. This person may be a representative of a specialist ventilation organisation or a member of the general manager/chief executive’s staff.

Appointment of postholders

2.15 All postholders should be appointed in writing by management. A record should be kept of those appointed to carry out the functions listed above. The record should clearly state the extent of the postholder’s duties and responsibilities, and to whom they are to report. (See paragraph # above)

2.16 Substitute or replacement staff should be designated in order to cover for sickness, holidays and staff transfers.

Ventilation safety group (VSG)

2.17 Each healthcare organisation, through its Ventilation Safety Group (VSG), should be able to demonstrate that they have suitable governance, competence and accountability arrangements in place to provide safe Critical Ventilation systems and appropriate clinical environments in their healthcare premises.

2.18 The VSG will be a multidisciplinary group formed to assess all aspects of ventilation safety and resilience required for the safe development and operation of healthcare premises, and it should inform the following areas:

- the design process for new healthcare premises;
- the design process for modifications to existing premises;
• the commissioning & validation process;
• operational management and maintenance;
• annual verification and performance testing;
• de-commissioning and removal of redundant equipment.

Note: Where estates and facilities provider services are part of a contract (including PFI), it is essential that these providers participate fully in all those aspects of estate and facilities management that can affect patients. This includes responding to specific requests from the VSG, which may be in addition to relevant guidance and documentation.

2.19 The VSG, through engagement with designers, will inform the development of safe and resilient ventilation systems within the healthcare environment. It will also provide assurance that the operation and maintenance of installed ventilation systems comply with the appropriate legislation and guidance and the healthcare provider’s local policy.

2.20 The VSG should have clearly defined roles and responsibilities, be part of a healthcare organisation’s governance structure and report to the designated person at Board level. It will be led and chaired by a person who has appropriate management responsibility, knowledge, competence and experience (for example, the IPC lead or head of estates).

2.21 It is important that decisions affecting the resilience, safety and integrity of the ventilation systems and associated equipment are not taken without the agreement of the VSG. The VSG should ensure that appropriate expertise and competence is available when making such decisions.

2.22 The VSG may typically comprise:

• the Authorised Person(s) for ventilation services;
• an Authorising Engineer/independent adviser for ventilation;
• an IPC representative;
• estates (operations and projects) staff;
• clinicians and specialist departments (e.g. operating theatres, critical care areas, aseptic preparation facilities in pharmacies, medical microbiology, nursing);
• personnel from the finance department with accountability for capital and revenue evaluation;
• other stakeholders as appropriate.
• co-opted expertise e.g. ventilation designers, consultants and suppliers.

Ventilation policy document

2.23 The VSG should produce a ventilation policy document for the healthcare provider. In its simplest form this may just be a statement that the healthcare provider will follow the guidance contained in HTM 03-01; Part B. It may also specify any departures from that guidance in terms of local additional requirements or derogations.
2.24 The policy document should be endorsed by the healthcare provider’s board.

**Risk assessment – routine inspection and maintenance**

2.25 Routine inspection and maintenance procedures can cause risks to the health of staff carrying out the work and those receiving air from the plant. All those involved should be made aware of the risks, and safe systems of work should be agreed and followed. Suitable safety equipment should be provided as necessary, and training in its use should be given. Records should be kept for five years (see paragraph 1.31 above).

2.26 Any training given should be recorded, together with the date of delivery and topics covered.

2.27 Training in the use of safety equipment and a safe system of work will need to be repeated periodically in order to cater for knowledge refreshment and changes in staff.

**Specific health and safety aspects**

2.28 Staff engaged in the service and maintenance of extract ventilation systems from pathology departments, mortuaries, laboratories, isolation facilities and other areas containing a chemical, biological or radiation hazard may be particularly at risk. In these cases, the risk should be identified and assessed.

2.29 The means by which the system can be rendered safe to work on should be determined, and a permit-to-work on the system implemented. Appendix 3 gives an example of a typical “equipment release certificate” (ERC) that could be used for routine inspection and maintenance by competent persons.

2.30 Training in the exact procedures should be given to all staff involved.

2.31 Some healthcare facilities may contain specialised units that are subject to access restrictions (for example, a pharmacy’s aseptic preparation facility). Estates or contract staff requiring access may need additional training or be accompanied when entering the unit.

2.32 See also the following guidance published by the Health & Safety Executive:

- ‘Safe working and the prevention of infection in clinical laboratories and similar facilities’;
- ‘The management and operation of microbiological containment laboratories’;
- HSG 283 – ‘Managing infection risks when handling the deceased: guidance for the mortuary, post-mortem room and funeral premises, and during exhumation’.
3 Ventilation systems – minimum standards

General requirements

3.1 In order to comply with the Building Regulations, all ventilation systems irrespective of when they were installed must be inspected annually to ensure conformity with minimum standards. These are designed to:

- assure the quality of intake air
- that extract air is discharged in a suitable location
- prevent or control risks associated with Legionella and other potential hazardous organisms;
- ensure safe access when carrying out routine service and maintenance activities;
- provide documentary proof of performance;

3.2 All AHUs should achieve the minimum standard set out below.

3.3 Note that these standards have not changed since HTM2025 was issued in 1994 so all systems currently in use should therefore achieve them.

Location and access

3.4 All ventilation plant should be secured from unauthorised access.

3.5 It is now a requirement to uniquely identify individual plantrooms on site and fix a list just inside the door detailing the major plant elements within and the areas they serve.

3.6 Plantrooms should where possible be provided with a sink so that glass drainage traps may be cleaned out and staff can wash their hands after handling dirty filters. A source of domestic hot water with a hose connection point will also be required so that AHUs can be washed out internally as part of their routine maintenance.

3.7 Units located on roofs should have a safe and permanent means of access. Suitable precautions must be in place to prevent personnel or equipment from falling off during maintenance activities.

3.8 Units located outside at ground level should be secured within a compound to prevent unauthorised access or preferably a plantroom. Vehicles should be excluded from the vicinity to ensure that exhaust fumes will not be drawn into intakes.
3.9 All parts of the AHU should be easily and safely accessible for routine inspection, service and maintenance.

3.10 The area around an AHU within a building should be tanked to prevent water penetration to adjacent areas, and should be adequately drained.

3.11 Fire precautions should be in accordance with the HTM 05 series.

3.12 Combustion equipment must not be located in a fire compartment that houses air-handling equipment.

3.13 Plantrooms that house AHUs should not be used for general storage. Care should be taken to ensure that the amount of combustible material in a plantroom is kept to an absolute minimum. Ventilation stock such as filters should be kept in a central store.

3.14 If a ready-use set of filters is kept in the plantroom, they should be stored off the floor so that they cannot become wet and are kept free from contamination. The number stored should be kept to a minimum to reduce the fire load in the plantroom. Used filters should be placed in an empty box or bag and removed immediately.

3.15 Spare fans should be stored on a purpose-built rack near the plantroom entrance. Staff should be instructed to “spin” the fan every time they enter the plantroom to help prevent the bearings settling.

**Basic requirements**

3.16 The ventilation system must not contain any material or substance that could support the growth of micro-organisms.

3.17 Access to items that require routine service, such as filters, fog coils and chiller batteries, should be via hinged doors.

3.18 Items requiring infrequent access such as attenuators may be via clipped or bolted-on lift-off panels.

3.19 All doors and panels should be close-fitting and without leaks.

3.20 Access to plant and equipment above 1.5 m should be via platforms, fixed ladders, hook ladders or pulpit-style movable steps.

3.21 Electrical and mechanical services should not restrict or impede access to those parts of the plant that require inspection.

3.22 Viewing ports and internal illumination should be fitted in order to inspect filters and drainage trays.

3.23 Internal illumination should be provided by luminaires to at least IP55 rating. Fittings should be mounted inside the unit so that they provide illumination for inspection and task lighting when the access doors are open.
3.24 A single clearly labelled switch should operate all lights in a unit.

**AHU intakes and discharges**

3.25 Intake and discharge points should not be situated where they will cause vitiated air to be drawn into a system (see paragraphs 3.57–3.68 in Part A, which give detailed information). In existing systems, it may be necessary to extend the intake or discharge point to a suitable position.

3.26 Each intake and discharge point should be fitted with corrosion-resistant weatherproof louvres or cowls to protect the system from driving rain. The inside of the louvres should be fitted with a mesh of not less than 6 mm and not more than 12 mm to prevent infestation by vermin and to prevent leaves being drawn in.

3.27 The duct behind a louvre should be self-draining. If this is not practicable, it should be tanked and provided with a drainage system. Cleaning access must be provided either from the outside via hinged louvres or by an access hatch or door in the plenum behind the louvre. Where a common plenum is provided, cleaning access should be via a walk-in door. If the intake plenum is a builders’ duct, all of its surfaces should be sealed to prevent dust being shed into the airflow.

**Plant drainage system**

3.28 All items of plant that could produce moisture must be provided with a drainage system. The system should comprise a drip-tray, borosilicate glass trap, air break and associated drainage pipework.

3.29 Some older units may not have been mounted far enough above the floor to permit the correct installation of a drainage system. If the AHU cannot be raised to an adequate height, an alternative arrangement (such as a pump-out system) must be provided.

3.30 The drip-tray should be constructed of a corrosion-resistant material (stainless steel is preferred) and be so arranged that it will completely drain. To prevent “pooling”, it is essential that the drain connection should not have an up-stand and that a slope of approximately 1 in 20 in all directions should be incorporated to the drain outlet position.

3.31 In AHUs that have access doors large enough for a person to enter, the drip-tray should be easily accessible for inspection and cleaning.

3.32 In AHUs with access doors too small for a person to enter, the complete drip-tray should be capable of being withdrawn. It should be clamped into the AHU with thumb screws so that it can be removed without the need for tools.

3.33 Each drip-tray should be provided with its own drain trap. The drain trap should be of the clear (borosilicate) glass type. This permits the colour of the water...
seal to be observed, thus giving an early indication of corrosion, biological activity or contamination within the duct (see Table 3).

3.34 The trap should have a means for filling and should incorporate couplings to facilitate removal for cleaning. It should be located in an easily visible position where it will not be subject to casual knocks. The pipework connecting it to the drainage tray should have a continuous fall of not less than 1 in 20.

3.35 Traps fitted to plant located outside or in unheated plantrooms may need to be trace-heated in winter. The trace-heating should be checked for operation and must not raise the temperature of water in the trap above 5°C.

3.36 Water from each trap must discharge via a clear air gap of at least 15 mm above the unrestricted spill-over level of either an open tundish connected to a drainage stack via a second trap, or a floor gully (or channel) or directly onto a roof. A support should be provided to ensure that the air gap cannot be reduced. More than one drain trap may discharge into the tundish, providing each has its own air break.

3.37 Drainage pipework may be copper, thermoplastic or stainless steel. Glass should not be used. The pipework should be a minimum diameter of 19 mm and have a fall of at least 1 in 60 in the direction of flow. It should be well-supported, and located so as not to inhibit access to the plant.

**Dampers**

3.38 All AHUs should be fitted with motorised low-leak shut-off dampers located immediately behind the intake and discharge of each supply and extract system. The damper actuators should be fitted with end switches and be spring return so that they close automatically on power failure.

**Fans and their drives**

3.39 Belt and pulley fan-drive trains external to the AHU, whether supply or extract, should be easily visible without the need to remove access covers. Protecting the drive train with a mesh guard is the preferred option. For weatherproof units located outside, the fan drive should be enclosed. It should be easily visible through a viewing port with internal illumination and be accessed via a lockable, hinged door.

3.40 Plug and EC fans units are mounted inside the AHU. Their access door should have a viewing port and internal illumination. The door should be fitted with a two-stage opening latch so that if the door is inadvertently opened when the fan is running it will not blow outwards.

3.41 The motor windings of induction-drive “plug” motor arrangements, EC fans and in-line axial fans having a pod motor within the airstream should be protected from over-temperature by a thermistor and lock-out relay.

3.42 Manual operation. (Do we continue with a manual override?)
Heater-batteries

3.43 Access for cleaning must be provided to both sides of all fog coils and heater-batteries.

Cooling coils

3.44 All cooling coils, whether within the AHU or a branch duct, should be fitted with their own independent drainage system as specified above. A baffle or similar device should be provided in the drip-tray to prevent air bypassing the coil, and the tray should be large enough to capture the moisture from the eliminator, bends and headers.

3.45 The cooling coil control valve should close upon selection of low speed, system shut-down, low airflow or fan failure.

3.46 Where auxiliary wet-cooling coils are located in false ceilings, they should be fitted with a catch tray and leak alarm. The catch tray should be installed under both the battery and the control valve assembly to protect the ceiling from leaks. A moisture sensor and alarm should be fitted in the tray.

Eliminators

3.47 Where fitted they should be removable so that the face of the cooling coil can be inspected and cleaned as necessary. In new units the eliminator should be mounted on slide rails for ease of removal. In existing systems, if bolted in position, it should be secured with thumb screws (not tech screws) and fitted with lifting handles to enable removal and replacement without the use of tools.

Humidifiers

3.48 Humidifiers are not generally required. Part A (Insert reference) gives examples of where humidification is required.

3.49 Where they are fitted, but have been out of use for a significant period of time, they should be removed. All associated pipework should also be removed back to its junction with the running main.

3.50 Where humidifiers are fitted and their use is still required, they should fully conform to the installation standard set out in Chapter 9 of Part A.

3.51 The section of ductwork containing the humidifier may need to be periodically decontaminated. Hinged access doors with viewing ports and internal illumination should be provided.

3.52 All humidifiers must be fitted with their own independent drainage system as detailed above (paragraph ##).

3.53 Only steam-injection humidifiers, whether mains-fed or locally generated, are suitable for use in air-conditioning systems within healthcare facilities. Water humidifiers, if fitted, should be removed.
3.54 Self- and locally generated steam humidifiers must be supplied with wholesome water. The installation should be capable of being isolated, drained and cleaned. Chapter 4 in Part A of this Health Technical Memorandum gives further details.

3.55 Some steam generators are of a type that requires regular cleaning and descaling. The installation should enable them to be physically isolated from the air duct in order to prevent contamination of the air supply by cleaning agents.

3.56 The humidifier control system should fully conform to the standard set out in Chapters # of Part A.

**Filtration**

3.57 Filters must be securely housed in well-fitting frames that minimise air bypass. Air bypass significantly reduces filter efficiency; the higher the filter grade, the greater the effect. In horizontal AHUs the mounting frames should be designed so that the airflow pushes the filter into its housing to help minimise air bypass.

3.58 All filters should be of the dry type. Panel filters are generally used as prefilters and should be positioned on the inlet side of the supply fan, downstream of the fog/frost coil. Where required, secondary filters (these will be bags or pleated paper) should be on the positive-pressure side of the fan.

3.59 The filter installation should provide easy access to filter elements for cleaning, removal or replacement; therefore, a hinged access door should be provided. The upstream side of the filter should be visible for inspection through a viewing port with internal illumination.

3.60 All filters should be provided with a means of checking the differential pressure across them. Direct-reading dial-type gauges marked with clean and dirty sectors are preferred.

*Note: Direct-reading gauges may be omitted (if desired) providing the filter differential pressure is measured with a pressure sensor connected to the BMS and there are capped tappings so that a portable gauge can be attached when required for diagnostic purposes or fault-finding.*

**High-efficiency particulate filters – HEPA**

3.61 Where fitted, HEPA filters should be of the replaceable-panel type with leak-proof seals. Their installation should permit the validation of the filter and its housing.

3.62 HEPA filters fitted in supply ducts must have a metal case so that they cannot support fungal growth.

3.63 HEPA filters are sometimes used in extract systems to prevent the escape of hazardous substances or organisms. They may be supplied with a particle board or plywood case so that they can be disposed of by incineration.
When used for the containment of hazardous substances, the installation should incorporate design provision for the subsequent safe removal and handling of contaminated filters by maintenance staff.

**Energy recovery**

3.65 Energy recovery, where fitted, will require cleaning access to both sides of the device.

3.66 Whichever type of energy recovery device is fitted, the extract side should be protected by an ISO ePM10 ≥ 50% filter and provided with a drainage system to remove condensate.

3.67 The energy-recovery device should be controlled in sequence with the main heater-battery, and may need to incorporate a control to prevent the transfer of unwanted heat when the air-on condition rises above the plant’s required set-point.

**Attenuation**

3.68 Cleaning access should be provided at both ends of any attenuator unit.

**Identification and labelling**

3.69 All ventilation systems should be clearly identified with a permanent label in accordance with the requirements of Section 1 para ###. The label should identify both the AHU and the area that it serves. The lettering should be at least 100 mm high and be mounted in an easily visible place near the fan of the unit adjacent to the local electrical isolator. Any subsystems and the principal branch ducts should be similarly labelled as should any associated control panels.

3.70 The direction of airflow should be clearly marked on all main and branch ducts. (See BS1710)

3.71 All airflow test-points should be clearly identified with a permanent label and the design information given. (e.g. TPS 1 – Anaesthetic supply; 400 x 300; Design 185L/s).

**Pressure stabilisers**

3.72 Pressure stabilisers should be unobstructed and silent in operation. (See Chapter 5 for maintenance requirements)

3.73 Pressure stabilisers that direct air into a UCV operating room should be baffled on the theatre side to prevent the air jet disturbing the UCV canopy air pattern. They may also need to be baffled if the jet of air from them creates uncomfortable conditions for patients or staff.

3.74 Where a pressure stabiliser incorporates a fire and smoke damper, the damper test switch or trip mechanism must be accessible from the corridor side without the need to remove the grille face, where fitted.
Chilled beams – active and passive types

3.75 Chilled beams should not be installed above a patient’s bed or diagnostic medical equipment. They should be easily accessible for cleaning and when fitted in a room with openable windows must have a cut-off switch to turn them off when the windows are opened.

Fan coil units

3.76 Fan coil units must not be installed above a patient’s bed or diagnostic medical equipment. They should be easily accessible for cleaning.

3.77 To avoid fungal-spore contamination, the ceiling void must not be used as a plenum either for supply, extract or as a return air path. All air connections must be ducted directly to the fan coil unit and ceiling terminals.

Portable air conditioners

3.78 Portable air conditioners are not recommended for use in healthcare premises.

Portable filter units

3.79 The need for standalone recirculating air filter units must be risk-assessed for every occasion that they are considered. If used, they must be subject to a strict cleaning and maintenance regime (See Chapter 5). Units no longer required will need to be stripped down, cleaned and decontaminated before being used again.

3.80 Standalone fan filter units that draw in outside air must do so through a bespoke sealable air intake through a wall, roof or window. They must not just be placed in front of an open window.

Low-level extracts

3.81 Low-level extracts should not be obstructed by fixed or portable equipment, furniture of fittings. If necessary, stand-off guarding should be fitted.

3.82 Low-level-extract grille faces should be of the pull-off type to facilitate routine cleaning. (See Part A; Chapter ~ for further information)

Fire and smoke dampers

3.83 All fire and smoke dampers must be fixed directly to the fabric of the building. They should have an access door with a test switch adjacent to it so that the actual operation of the damper can be directly observed during the annual test.

Control panels

3.84 Ventilation control panels of any type and purpose should be clearly marked with the unique identifier of the plant that they control and the area / zone that the plant serves.
3.85 Inverters must not be located within the airstream inside an AHU. They should be mounted externally with the readouts of control pads and plant data screens visible at a convenient height. Their settings may be password-protected, but they must be adjustable e.g. switched to manual, without the need to isolate plant or unlock access panels.

**Theatre, imaging and treatment room panels**

3.86 Local control panels must have a clear means of indicating that the ventilation is operating to a satisfactory standard for the application. The minimum requirement would be a green light for “on” and a red light for “set back”, “off” or “fault”. The panel should also display the room temperature and have a means of adjusting it. *(See HTM 03-01; Part A; paragraph #)*

3.87 The Specialised Ventilation for Healthcare Society’s (SVHSoc) document ‘Operating Theatres - Energy Control Strategies and the Surgeon’s Panel’ gives additional information of minimum standards for a variety of panel types.

**Energy efficiency**

3.88 The basic objective will be to provide the necessary service utilising the least amount of energy possible. To this end switching a system “Off” when not required is the most energy-efficient policy.

3.89 If the system is needed to maintain a minimum background condition, reducing its output to the minimum necessary to achieve and maintain the desired condition is the next best option.

**Note on “set back”:** In many existing systems, the fan motor has two speeds so turning the system down means switching to the lower fan speed and hence air volume. With modern inverter-controlled or EC fans the speed is infinitely variable so “set back” is not a fixed fan speed but rather a control strategy that reduces the system output in order to maintain a desired minimum condition. This may be related to the air velocity at a fixed point, air change rate, pressure differential, temperature, humidity or a combination of any of these parameters.

3.90 The system should only run at full output when needed to achieve and maintain the defined in-use operating condition

3.91 Care should be taken to discover the true “in use operating condition”. Overstating the condition will lead to oversized plant, unstable control and excessive energy consumption.

3.92 A ventilation system should not be run at full output “just in case it will be needed”. This is a particular problem in operating departments where the ventilation is often run out of hours as it is believed that it will maintain sterility in the operating suite. However, it is well known that the patient and theatre staff are the main source of airborne bacteria as they can disseminate infectious particles via skin flora into the surrounding theatre environment during a surgical procedure. Operating theatre ventilation is provided to cater for this in-use biological load. When the theatre is not in use, there is no
biological load and therefore the ventilation can be turned off and set to automatically start at “set back” (see note after paragraph 3.89) in order to maintain a minimum background condition e.g. room temperature, if needed. The time taken to start the ventilation and achieve full operating conditions in an emergency will be less than the time taken to bring a patient to theatre and prepare the staff and instruments ready for emergency surgery to commence.

3.93 The selection of set points for an AHU and associated extract system will have a significant impact on the overall energy consumption and efficiency of the system as a whole.

3.94 The control strategy for existing systems should be reviewed in line with the above guidance. (See Part A; Chapters 6 and 9 for further information.)

**Note:** Energy-recovery devices are mandatory for all new and refurbished AHUs. Where installed, they provide a significant portion of the heating requirement and the size of the AHU heater battery will have been reduced as a consequence. It is therefore essential that the energy-recovery device operates as intended and is well maintained.
4 Annual inspection and verification requirements

Ventilation systems inspection

4.1 All ventilation systems must be subject to at least a simple visual inspection annually.

4.2 The purpose of the inspection is to establish that:

- the system is still required;
- the plant conforms to the minimum standard (see Chapter 3);
- the fire containment has not been breached;
- the general condition of the system is adequate for purpose;
- the system overall is operating in a satisfactory manner.

4.3 It is recommended that a simple check-sheet be used to record the result of the inspection. Examples are given in Appendices 1 and 2.

Critical ventilation systems

4.4 All critical ventilation systems should be inspected quarterly and verified at least annually. In some circumstances the verification may need to be carried out more frequently.

4.5 The quarterly inspection should be as detailed in paragraphs 4.1–4.3.

4.6 The purpose of the annual verification will be to additionally ensure that the system:

- achieves minimum standards specific to the application;
- is operating to an acceptable performance level;
- remains fit for purpose.

Definition of a critical system

4.7 Ventilation systems serving the following are considered critical:

- operating theatres of any type, including rooms used for interventional procedures
- airborne isolation facility
- critical care areas
• neonatal intensive care
• bronchoscopy room
• containment level 3 laboratory
• aseptic preparation facilities in pharmacies
• inspection, assembly and packing (IAP) room in a sterile services department
• MRI, CAT and other types of emerging imaging technologies that require particularly stable environmental conditions to remain within calibration
• any system classified as a LEV system under the COSHH Regulations
• any other system that clearly meets the definition that “a loss of service from such a system would seriously degrade the ability of the premises to deliver optimal healthcare”.

**Annual verification**

4.8 The annual verification is intended to establish that:

• the system is still required
• the AHU conforms to the minimum standard (see Chapter 3);
• the fire containment has not been breached;
• the general condition of the ventilation system is adequate;
• the fabric of the area served is suitable for the function;
• the system performance is adequate with respect to the functional requirement – this will require:
  - the measurement of all system supply and extract airflow rates
  - the calculation of room air-change rates if applicable
  - the measurement of room differential pressures if applicable
  - the measurement of room noise levels
  - temperature, humidity and any application specific air velocity measurements
  - a check of the control functions *(SVHSoc to compile an example check list?)*
  - microbiological air-quality sampling if required
4.9 An assessment should then be made on whether the system overall is fit for purpose and operating in a satisfactory manner.

Fabric of the area served

4.10 The building elements in the room or rooms served by a critical ventilation system should also be suitable for the function. As an example, in a suite of rooms comprising an operating theatre complex, the following elements should be checked:

- the ceiling should be complete and free from holes, gaps or obvious air-leakage paths. All light fittings, access hatches and suspended fittings should be sealed to prevent uncontrolled air leakage. It is important to check for air-leakage paths behind the cover shrouds where operating-lamp stems and medical-gas and monitor suspension booms penetrate the ceiling.
- the walls and floors should be free from significant construction and finish defects;
- windows and their trickle vents should be sealed and locked shut;
- the doors should close completely, and the door closers should be correctly adjusted to hold them against the room pressure gradient;
- all service penetrations and access panels should be sealed to prevent uncontrolled airflow between rooms and service voids;
- steps should be taken as necessary to prevent portable equipment and stock items from obstructing low-level supply, transfer or extract airflow paths.

4.11 Failure to achieve a suitable standard will render even the most sophisticated ventilation system ineffective.

4.12 All fire and smoke dampers should be tested as part of the annual verification unless the local policy dictates otherwise.

4.13 Table 1 provides a model for the verification of critical ventilation systems.

4.14 LEV systems will be subject to an examination and test by a competent person at least every 14 months. An individual who holds an in-date P601 certificate will be considered competent. (See Appendix #)

Critical ventilation systems – verification standards

4.15 Unless otherwise specified below, the ventilation system should achieve not less than 75% of the design air-change rate given in Part A; Chapter 8, or its original design parameters.
4.16 The pressure regime should achieve not less than 75% of the design value given in Appendix 2 of Part A, or its original design parameters; and the pressure gradient relationships with regard to surrounding areas should be maintained.

4.17 The sound levels given in Table 2 are maximum permissible levels and should not be exceeded. Measurements should be made using at least a Type 2 sound meter fitted with a muff. Its accuracy should be checked using a calibration sound source before use.

4.18 Notwithstanding paragraph 4.15 above:

- The primary air supply to a conventionally ventilated operating theatre, ultra clean ventilated (UCV) operating theatre or “lay up” preparation room should not result in less than 18 air changes per hour in the room. Note the volume of the theatre to be calculated using the method given in HTM 03-01; Part A; Chapter #; Para #
- The primary air supply to an operating department recovery room or an operating theatre anaesthetic room that is equipped with an N\textsubscript{2}O terminal or in which an anaesthetic agent is delivered to the respiratory tract of a patient using a carrier gas should not result in less than 12 air changes per hour.
- The primary air supply to any other room that is equipped with an N\textsubscript{2}O or N\textsubscript{2}O/O\textsubscript{2} (entonox) terminal or in which an anaesthetic agent is delivered to the respiratory tract of a patient using a carrier gas or in which the patient is subsequently recovered should not result in less than 8 air changes per hour.

**Vertical-flow ultra-clean ventilated (UCV) operating theatres**

4.19 The following additional measurements should be taken:

- the average air velocity at the 2 m level under the UCV canopy: it should achieve a minimum average of 0·38 m/s for a partial or no-wall system and 0·3 m/s for a full-wall system;
- the average air velocity for each quadrant or actively ventilated section of the canopy should not exceed +/−6% of the measured average velocity for the canopy;
- the air velocity within the inner zone at the 1 m level: every reading should achieve a minimum velocity of 0·20 m/s.

4.20 The air velocity measurements are to be taken using the equipment, test grid and method set out in Chapter 12 of Part A.

**Note**

There is no requirement to carry out filter scanning, particle counting / DOP testing or entrainment tests at the annual verification unless the HEPA filters or recirculating air fans are changed, or the system is in some other significant way disturbed or altered.
Changing the filters in the AHU or the recirculating air filters in the UCV canopy does not constitute a significant disturbance to the UCV unit.

Should the UCV canopy fail to achieve a suitable standard, resulting in the need to disturb or replace the canopy HEPA filters or its auxiliary fans, the unit should be revalidated using the procedure given in Chapter 8 of Part A.
Table 1  Operational management and routine verification process model

<table>
<thead>
<tr>
<th>Step</th>
<th>Question</th>
<th>Information/standard required</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Is the system still required?</td>
<td>Why was it installed?</td>
<td>Is that function still required?</td>
</tr>
<tr>
<td>2</td>
<td>Does the AHU achieve the minimum standard?</td>
<td>Health and safety aspects, Intake/discharge positions, Inspection access, Legionella control and drainage, Fire and electrical safety, Leaks, cleanliness and insulation, • FILTRATION</td>
<td>Inspect to ascertain compliance with minimum standards set out in Chapter 3 of Health Technical Memorandum 03-01 (Part B)</td>
</tr>
<tr>
<td>3</td>
<td>Is the air distribution system satisfactory?</td>
<td>Access, Fire dampers, Cleanliness, Insulation, Identification, Room terminals, • Pressure terminals</td>
<td>Inspect to ascertain continued fitness for purpose</td>
</tr>
<tr>
<td>4</td>
<td>Does the measured system performance still accord with the design intent and achieve a minimum acceptable standard?</td>
<td>Design air velocities, Design airflow rates, Room air-change rates, Pressure differentials, Noise levels, • Air quality</td>
<td>Establish the design values</td>
</tr>
<tr>
<td>5</td>
<td>Does the control system function correctly?</td>
<td>Desired environmental conditions, Control sequence logic, • Run; set-back; off philosophy</td>
<td>Establish the design requirement, Inspect/test to verify performance</td>
</tr>
<tr>
<td>6</td>
<td>Having regard to the foregoing, is the system “fit for purpose” and will it only require routine maintenance in order to remain so until the next scheduled verification?</td>
<td></td>
<td>Yes or No!</td>
</tr>
<tr>
<td>7</td>
<td>What routine service and maintenance will be required for the system to remain fit for purpose and function correctly until the next scheduled verification?</td>
<td>Filter changes, System cleaning, Performance indication, Performance monitoring, • Performance measurement</td>
<td>Decide inspection frequency and maintenance schedule</td>
</tr>
</tbody>
</table>

Table 2  Maximum sound levels (service noise only)

<table>
<thead>
<tr>
<th>Location</th>
<th>Design sound level (NR)</th>
<th>Measured sound level (dB(A))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultra-clean operating room</td>
<td>50</td>
<td>55</td>
</tr>
<tr>
<td>Conventional operating room</td>
<td>40</td>
<td>45 (50 for HTM2025 installations)</td>
</tr>
<tr>
<td>All other non-specified rooms</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>Corridors</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>Recovery room</td>
<td>35</td>
<td>40</td>
</tr>
</tbody>
</table>
Horizontal-flow ultra-clean operating theatre terminals

4.21 The following additional measurements should be taken:

- A line of test positions should be marked on the floor 1 m in front of the face of the UCV terminal.
- A test position should be marked in the centre of the line. Additional test positions should be marked at 280 mm spacing along the line either side of the centre position, up to the full face width of the unit.
- The discharge velocity test at 1 m, 1.5 m and 2 m levels in front of the terminal are taken at each test position.
- The average velocity should be not less than 0.40 m/s.

4.22 The measurements are to be taken using the equipment and method set out in Part A; Chapter 12.

Note

There is no requirement to carry out filter scanning at the annual verification unless the HEPA filters or recirculating air fans are changed; or the system is in some other significant way disturbed or altered.

Changing the filters in the AHU or recirculating air filters does not constitute a significant disturbance to the UCV terminal.

Should the horizontal UCV fail to achieve a suitable standard, resulting in the need to disturb or replace the canopy HEPA filters or auxiliary fans, the unit should be revalidated using the procedure given above.

Containment level 3 laboratories

4.23 These areas should conform to the requirements of current information published by the Advisory Committee on Dangerous Pathogens and the Health and Safety Executive:

- ‘The management, design and operation of microbiological containment laboratories’;
- ‘Biological agents: managing the risks in laboratories and healthcare premises’;
- ‘Biological agents: the principles, design and operation of Containment Level 4 facilities’.
4.24 The Head of Department will be able to advise on any mandatory plant inspection and maintenance frequencies and particular control strategy. The performance measurement of a containment laboratory is normally contracted out to a specialist.

Pharmacy – aseptic preparation facilities

4.25 Pharmacy aseptic preparation facilities should conform to the requirements of the European guide to good manufacturing practice (https://ec.europa.eu/health/documents/eudralex/vol-4_en) and the requirements of the Medicine Inspectorate if a licensed manufacturing unit.

[Should we also refer to HBN 14-01 and Royal Pharmaceutical Society standards?]

4.26 The Chief Pharmacist will be able to advise on any mandatory plant inspection and maintenance frequencies and particular control strategy. The performance measurement of aseptic preparation facilities is normally contracted out to a specialist.

Sterile services department – IAP

4.27 IAP rooms should conform to the standard as defined for a Class 8 clean room (BS EN ISO 14644) and any additional requirements for the processing of medical devices, as applicable (see also Health Building Note 13 – ‘Sterile services department’).

4.28 The Head of Department will be able to advise on any mandatory plant inspection and maintenance frequencies and particular control strategy. The performance measurement of the IAP room is normally contracted out to a specialist.

LEV systems

4.29 LEV systems should conform to the Health and Safety Executive’s guidance document HSG258 (2017) ‘Controlling airborne contaminants at work: a guide to local exhaust ventilation (LEV)’.

4.30 LEV systems must be examined and tested at least once every 14 months by a competent person. The person must hold an in-date P601 certificate.

4.31 Each LEV system must be inspected and its performance measured and/or visualised from the point of capture of the hazard to its point of discharge. A full report of findings and a clear statement as to whether the system does or does not achieve an acceptable standard must be provided by the inspector.

Critical system verification failure

4.32 Should a critical system be unable to achieve the standard set out above, it should not be returned to service and the duty manager who signed the system over for the annual verification must be informed immediately. Copies of the verification report stating the reason(s) for non-compliance should be sent to the head of the user department, nominated IPC lead and the healthcare provider’s AP(V) as soon as practicable.
4.33 If a critical system is refurbished in order to bring it to a suitable standard, it should be subject to the full validation procedure as set out in Chapter 12 of Part A or other application-specific guidance as appropriate before being taken back into use.
5 Routine inspection and maintenance

General

5.1 Inspection and maintenance activities should be risk-assessed to ensure that they do not create a hazard for those who undertake the work or for those who could be affected by it.

5.2 The degree and frequency of inspection and maintenance should relate to the function of the system, its location, its general condition and the consequence of failure.

5.3 Specimen inspection and maintenance checklists are given in the Appendices.

Inspection and maintenance of critical systems

5.4 The loss of service of these systems would seriously degrade the ability of the premises to deliver optimal healthcare. In order to ensure reliable service provision, critical systems should be subject to a quarterly inspection and maintenance regime.

5.5 For many of these systems, an equipment release or permit-to-work certificate will need to be completed to ensure that taking the ventilation system out of service does not compromise the activities of the user department. In any event, it will be necessary to liaise with the user department when switching the system off to carry out routine inspection and maintenance.

Note: A specimen “equipment release certificate” is given in the Appendices.

AHU routine inspection

5.6 All AHUs should be at least visually inspected at least every 3 months. The inspection should note the general condition of the unit in terms of:

- its external and internal condition
- pipework and electrical connections
- sensor and control elements
- the units continued ability to maintain the desired condition in the spaces that it serves.

Note:

Where fitted, energy-recovery devices provide a significant portion of the heating requirement, and the size of the AHU heater battery will have been reduced as a consequence. It is therefore essential to check that the energy recovery device operates as intended.
AHU drainage

5.7 AHU drainage systems comprise a drainage tray, glass trap, connecting pipework and an air break. The system should be inspected to ensure that it is clean and operating correctly. The cleanliness of the drainage tray and colour of the water in the trap will give an indication of a fault condition (see Table #).

<table>
<thead>
<tr>
<th>Colour of water</th>
<th>Probable cause and comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Green</td>
<td>Copper corrosion of pipework</td>
</tr>
<tr>
<td></td>
<td>Possible leak in battery tubing</td>
</tr>
<tr>
<td>White</td>
<td>Aluminium corrosion of battery fins</td>
</tr>
<tr>
<td>Black</td>
<td>General dirt</td>
</tr>
<tr>
<td></td>
<td>Filter faulty allowing air bypass</td>
</tr>
<tr>
<td></td>
<td>Possible Aspergillus contamination</td>
</tr>
<tr>
<td></td>
<td>System is overdue for a thorough clean</td>
</tr>
<tr>
<td>Brown/red</td>
<td>Iron corrosion (rust) within the duct may indicate a specific Legionella hazard Immediate action required</td>
</tr>
<tr>
<td>Bubbly/slimy</td>
<td>Microbiological activity within the AHU may indicate a specific Legionella hazard Immediate action required</td>
</tr>
</tbody>
</table>

Filter changing

5.8 Dirty supply air filters may pose a general dust hazard when being changed.

5.9 Dirty extract and return air filters may pose an increased level of hazard. This will relate to the particular contamination within the air that they have filtered. Filters handling extract air from general areas are unlikely to present a significantly greater hazard than that posed by dirty supply air filters.

5.10 Care should be taken to protect staff from inhaling the dust. If there is a need to enter the duct when changing filters, a dust mask should be worn (e.g. respirator to BS EN 149). Dirty filters should be carefully removed and placed in the box that contained the replacement filters, or in a bag. On completion of the work, the dirty filters should be removed from the plantroom and disposed of appropriately. Note that used general supply or extract filters are not classed as hazardous waste.

5.11 The duct in the area of the filter housing should be carefully vacuumed using a cleaner with a filtered exhaust before fitting the replacement filters. This will prevent particles (that is, those that are shed when the dirty filters are disturbed) being blown downstream into the system when it is switched on.

5.12 It is important to ensure that replacement filters are fitted the right way round. Most panel filters are manufactured with a membrane or wire support mesh on their downstream side. Alternatively they may be colour-coded. The manufacturer’s instructions regarding fitting should be followed.
5.13 Bag filters should be fitted with the pockets vertical. Care should be taken to remove any transit tapes and to ensure that the individual pockets are separate and free to inflate.

Note: The preferred option is to replace bag filters with rigid assembly filter packs.

5.14 Whichever type of filter is fitted, it is essential to ensure that air cannot bypass it.

Changing extract filters containing hazardous substances

5.15 Filters handling extract air from an LEV system will obviously present a hazard and should be subject to a safe system of work.

5.16 Filters used in an extract system for the containment of hazardous substances or organisms should incorporate design provision for their safe removal when so contaminated. This may be achieved by:

- coating the filter with a water-based paint to seal the hazardous substance onto the filter prior to removal;
- a system to fumigate the filter to kill any organisms;
- housing it in a “safe change” unit that permits the filter to be ejected into a bag and sealed without staff having to come into direct contact with it.

The method chosen should reflect the nature of the hazard.

5.17 Filters fitted to remove hazardous substances from extract air are classed as hazardous waste and should be handled and disposed of accordingly.

Air terminals

5.18 Soot marks around supply terminals should be vacuumed or wiped clean. Excessive soot marks around supply diffusers indicate an inadequate filter or significant filter bypass.

5.19 Extract grilles need to be regularly cleaned of dust and fluff. Low-level spring-retained extract grilles should be regularly removed so that they can be washed and the debris in the duct behind them vacuumed out.

UCV canopies

5.20 UCV canopies fitted with perforated plate-type diffusers should have them removed and both sides wiped clean at the quarterly inspection. Any canopy side screens should be wiped down on both sides to remove surface contamination and bone dust.
5.21 UCV canopies fitted with mono-filament diffuser screens do not need to be removed as blood splatter does not easily penetrate. Any visible surface contamination should be carefully wiped off in accordance with the manufacturer’s instructions. If the mono-filament screen is cut, punctured or physically damaged, it must be replaced, not repaired.

5.22 The return air grilles for all types of canopies will need to be regularly cleaned to remove lint and the return air filters replaced as necessary.

**Pressure stabilisers**

5.23 Plate and bar stabilisers need to have their screws tightened, the pivots cleaned and adjusted, and the sorbo rubber stop inspected and replaced as necessary if they are to operate correctly and silently.

5.24 All types of pressure stabilisers to be checked for correct and silent operation and cleaned as necessary.

**Transfer grilles**

5.25 Both sides of a transfer grille should be vacuumed to remove dust and fluff.

**Ventilation system cleaning**

5.26 The intake section of a ventilation system should be vacuumed-out as necessary to remove visible particles.

5.27 AHUs should be vacuumed-out and wiped or washed down internally as necessary to remove obvious dust and dirt.

5.28 Drift eliminators (if fitted) should be removed. Cooling coils, humidifier units, energy-recovery devices and their drainage systems should be washed down with hot water annually to remove visible contamination. Using a hose connected to the DHW is the simplest way. Pressure washers should not be used as they will damage the battery fins or energy transfer matrix.

5.29 Supply-air distribution ductwork conveys air that has been filtered. It will require internal cleaning only when it becomes contaminated with visible dirt. The frequency of cleaning will depend on the age of the system and grade of the AHU final filter but will typically be in excess of ten years. There is no requirement to clean supply ductwork annually. A rapid build-up of visible dirt within a supply duct is an indication of a failure of the filtration or its housing.

5.30 On completion of cleaning, the supply ductwork should not be “fogged” with chemicals. This treatment has no lasting biocidal effect and is responsible for initiating the breakdown of the galvanised coating of ductwork. This results in accelerated corrosion of the inside of the duct, with the products of corrosion...
being shed into the airstream. It will also significantly shorten service life.

Note: If after duct cleaning, there are persistent problems with fungal spores being discharged from the supply terminals, air samples should be taken at the AHU air intake, AHU supply air discharge and at least one supply terminal per branch. This should pinpoint the actual source of the problem. The affected section should then be inspected, recleaned and finally fogged if that proves necessary.

5.31 Extract air systems handle unfiltered air. They should be cleaned as frequently as necessary in order to maintain their operating efficiency. Room extract terminals, particularly those sited at low level in critical care areas, will need regular cleaning.

5.32 Following duct cleaning, all service hatches should be checked to ensure that they have been correctly replaced and do not leak.

5.33 Duct-cleaning equipment that uses rotating brushes or a vacuum unit can easily damage flexible sections of ductwork. On completion of cleaning, all flexible duct sections should be checked for rips and tears. The opportunity should be taken to reduce flexible ducts in length to the absolute minimum and replace any being used in lieu of bends with rigid duct sections. The straps that secure them to rigid duct sections and air terminals should also be checked to ensure that there is no air leakage.

Note:

1. If the system has mixing or VAV boxes, the cleaning contractor should be alerted and use a method that avoids damaging any internal acoustic lining.

2. Duct-mounted sensors and the elements of electric and fins of heating or cooling trimmer batteries can also be easily damaged during duct cleaning. Sensor probes may need to be temporarily removed and the battery elements protected during the process.

5.34 It is always necessary to rebalance the ventilation system following cleaning as balance dampers and registers will have been disturbed. The system will then need to be validated in accordance with Chapter 12 of Part A.

Chilled beams – active and passive types

5.35 The efficiency of these units will rapidly decline if they become blocked with fluff/lint. They should be inspected every three months and cleaned as appropriate.

Split and cassette air-conditioning units

5.36 These units incorporate internal recirculation air filters and a drainage system to remove condensate from the cooling coil. The systems should be inspected and cleaned every three months and the drainage system checked.
**Fan coil units**

5.37 These units incorporate internal recirculation air filters and a drainage system to remove condensate from the cooling coil. The systems should be inspected and cleaned every three months and the drainage system checked.

**Portable room air-conditioning units**

5.38 Portable units are sometimes kept in-store or hired-in to cope with temporary local situations giving rise to excessive temperatures. They typically incorporate internal recirculation air filters and a drainage system to remove condensate from the cooling coil. The IPC team must be consulted before these types of unit are deployed.

5.39 The units should be inspected and thoroughly cleaned before being taken into use. Units that are to be used in areas containing immuno-compromised patients will, unless new, need to be fully decontaminated before use.

5.40 All portable units should be inspected and cleaned every week that they remain in use.

5.41 Units that have been used in isolation rooms or areas containing infectious patients will need to be fumigated before being used in other locations, returned to store or to the supplier.

5.42 Units employing an internal water reservoir and wick to promote evaporative cooling must not be used in healthcare premises.

**Self-contained mobile filter and/or ultraviolet (UV) light units**

5.43 The efficacy of these units is directly related to their cleanliness. In this respect, the manufacturer’s instructions regarding service/maintenance and lamp and filter replacement should be closely followed. (See also Chapter 3, paragraphs 3.80-3.81.)

5.44 Units that have been used in isolation rooms or areas containing infectious patients will need to be fumigated before being used in other locations, or returned to store.

5.45 Filters fitted to remove hazardous substances from the recirculated room air are classed as hazardous waste and should be handled and disposed of accordingly (see also Health Technical Memorandum 07-01 – ‘Safe management of healthcare waste’).

**Inspection and maintenance records**

5.46 Records of inspection and maintenance activities should be kept for at least five years. (See paragraph 1.24 above)
Appendix 1 – Annual inspection of critical ventilation systems – AHU and plantroom equipment

Appendix 2 – Operating suite annual verification

Appendix 3 - Equipment Release Certificate
Appendix 4

Notes on Measuring system performance

Airflow in Ducts
Equipment – Method - Accuracy
Pitot & Manometer; Hot wire anemometer

Airflow at Supply terminals
Equipment – Method - Accuracy
Balometer correction factors; Rotating vane anemometer

Airflow at extract terminals
Equipment – Method - Accuracy
Balometer correction factors; Rotating vane anemometer

Calculation of air change rates
Gross and net room volumes

Air velocity in free air
Equipment – Method - Accuracy

Differential pressure measurement
Equipment – Method - Accuracy

Noise measurement
Equipment – Method - Accuracy

Particle counting
Equipment – Method - Accuracy

DOP testing
Equipment – Method - Accuracy

Microbiological testing
Equipment – Method – Accuracy