Scottish Health Technical Memorandum 2025

(Part 4 of 4)

Operational management

Ventilation in healthcare premises

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Contents

1. Introduction

General

1.1 Ventilation is used extensively in healthcare premises for primary patient treatment eg. in operating departments, intensive treatment units and isolation suites. It is also installed to ensure compliance with quality assurance of manufactured items in pharmacy and sterile supply departments and to protect staff from harmful organisms and toxic substances for example in laboratories.

1.2 This edition of Scottish Health Technical Memorandum 2025; *Ventilation in healthcare premises* is published in four separate parts. It is equally applicable to both new and existing sites. It gives comprehensive advice and guidance to healthcare management, design engineers, estates' managers and operations' managers on the legal requirements, design implications, maintenance and operation of specialist ventilation in all types of healthcare premises.

1.3 Current statutory legislation requires both "management" and "staff" to be aware of their collective responsibility.

1.4 "Ventilation" is provided in healthcare premises for the comfort of the occupants of buildings. More specialised ventilation will also provide comfort but its prime function will be to closely control the environment and air movement in the space that it serves in order to contain, control and reduce hazards to patients and staff from airborne contaminants, dust and harmful micro-organisms.

1.5 Ventilation systems, in themselves, present little danger to patients or staff; however, they do possess the ability to transmit hazards arising from other sources to large numbers of people. The danger may not become apparent in a recognisable form until many patients and staff have been affected.

1.6 The sophistication of ventilation systems in healthcare premises is increasing. Patients and staff have a right to expect that systems will be designed, installed, operated and maintained to standards that will enable them to fulfil their desired functions reliably and safely.

2. General

Management responsibilities

2.1 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.

2.2 Clear lines of managerial responsibility should be in place so that no doubt exists as to those who are responsible for the safe operation and maintenance of the equipment. A periodic review of the management systems should take place in order to ensure that the agreed standards are being maintained.

2.3 Ventilation plant that has been installed in order to meet a statutory requirement should be subject to periodic inspection and testing by an independent organisation. Typically these would include plants installed to provide ventilation to enclosed workplaces, manufacturing pharmacies, laboratories and local exhaust ventilation (LEV) systems. It is a management responsibility to ensure that the standards applied during their design and installation are not reduced during operation and maintenance of the equipment and that records of maintenance activity and routine inspections are kept.

2.4 Those required to monitor and/or maintain ventilation equipment and more specialist installations should be competent to do so. As a minimum they will need to possess sufficient knowledge of its correct operation so as to be able to recognise faults.

2.5 Routine maintenance procedures can cause risks to the health of both staff carrying out the work and those exposed to air from the plant. Those engaged should be made aware of the risks, safe systems of work agreed, suitable safety equipment provided and training in its use given.

2.6 All service and maintenance procedures should conform to the principles set out in the 'Approved Code of Practice on the Prevention or Control of Legionellosis' published by the Health and Safety Commission, and Scottish Health Technical Memorandum (SHTM) 2040; *The control of legionellae in healthcare premises - a code of practice*.

2.7 Regular tests, at intervals agreed with the local fire prevention officer, will need to be carried out in order to demonstrate the continuing efficiency of the fire detection and containment systems. Records of these tests should be kept.

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

Information

2.9 In order that the installation can be properly maintained and operated, it is essential that the following documentation is available:

a. “as fitted” drawings;

b. plant information manuals containing manufacturers' equipment information and operating instructions;

c. commissioning manuals listing the results of commissioning tests as detailed in the ‘Validation and verification’ part of this SHTM.

2.10 The commissioning manual will provide full information about:

a. the design intent;

b. the design conditions, inside and outside, summer and winter;

c. the design and commissioned volumetric air flow rates in ducts, at outlets and across transfer grilles and balance flaps;

d. the filter grades specified including their clean and dirty pressure drops and dust holding capacities;

e. the individual heater and cooler batteries’ capacity, face velocity, flow and return temperature and mass flow rate. Also their design “on” and “off” coil air-condition, summer and winter;

f. individual fan speeds, power consumption and differential static pressure generated at each operating speed. The total system resistance with both clean and dirty filters;

g. full information as to the designed operation of the plant together with recommended maintenance procedures.

The information listed above may not be available for many existing ventilation systems. Every effort should be made to compile it either by reference to original documents or by direct observation and measurement.

Operational procedures

2.11 The following operational procedures should be defined. The procedures may need to be modified in the light of experience gained in the actual operation of the plant:

a. the safe plant start, run, set-back, restart and stop procedures including minimum run up times to achieve desired operating conditions;

b. the frost protection sequence;

c. the condensation protection sequence (if required);

d. the arrangements to protect the plant and prevent it becoming a source of infection if it is left unused for extended periods.

2.12 Schedules of routine maintenance activities, suggested spares lists and operational information should be prepared.

2.13 The actual frequency of any particular maintenance activity and the need for planned preventative maintenance can only be finally determined after monitoring the plant in operation.

2.14 The following information should be provided adjacent to the plant to which it refers:

a. general information regarding the intended operation of the plant together with a schematic diagram of the equipment and its distribution system;

b. specific information as to the purpose of the plant and details of those departments and/or personnel that should be informed prior to switching off or carrying out maintenance activities. For example, in the case of a pathology laboratory extract, the department in general and the staff of the laboratory served by the plant in particular would need to be informed. If it is also deemed necessary to post warning notices within the laboratory, at the point of use, stating that the plant is out of operation for maintenance, then this should be set out in the specific plant maintenance information;

c. specific information required for the safety of the personnel carrying out the service and maintenance activities. This would include:

   (i) any special procedures to be followed before switching off the plant;

   (ii) any special precautions to be taken when opening up the plant. This will be required in order to guard against radioactive, biological, chemical and general dust hazards;

   (iii) the need to isolate other plants so that they do not present hazards during the maintenance activities due to common duct systems, reverse air flows or pressure imbalances.

In all cases the personnel given the task of carrying out the maintenance activities must be made aware of the safe procedures to be adopted. They should be informed of the hazards to themselves and others that may occur if the agreed procedures are ignored.

Training

General

2.15 The users and those who maintain “specialised ventilation systems” will need to be instructed in its safe operation. The instruction given should draw particular attention to the following topics:

a. the prime function of the system;

b. the intended method of operating the plant or equipment;

c. the interrelationship between “specialised ventilation systems”, general area systems and natural ventilation;

d. problems and hazards that can arise from failing to follow the agreed operating, monitoring and maintenance procedures;

e. the permit-to-work in use (if appropriate);

f. the danger of making unauthorised modifications, alterations or additions to the system as well as the possible legal consequences;

g. the procedure to be followed if it is suspected that the system is no longer operating correctly.

Operating department staff

2.16 Users should be properly informed and instructed as regards the use of the plant to provide correct environmental conditions. Surgeons in particular need to have an understanding of how the plant provides the conditions they require. The operating department users' committee should be encouraged to follow the recommendation of making one person, possibly the operating department(s)' manager, responsible for adjustment to achieve working environmental conditions to suit the operating list.

2.17 When the list is prepared surgeons should state on the list the particular conditions they require within the theatre. The responsible person should then adjust the control panels in sufficient time to achieve these conditions and should also follow the essential procedure of ensuring that all doors are closed and remain closed.

2.18 The control of humidity and temperature must be used in the correct manner taking into consideration the plant capability to provide required conditions. User staff must also appreciate that if the control sensors are to achieve the required conditions, operating room (O/R) doors must be kept closed.

2.19 When an ultra-clean ventilation (UCV) system is designed to have partial walls with full wall extensions, a volume control facility may be incorporated to allow the system to be run with reduced velocity when the demountable full walls are in place. The user will be responsible to ensure the correct operation of the system, but to assist the user its operation should be demonstrated and a warning notice should be included on the control panel.

NOTE: The user should be particularly aware that in the case of an UCV system, selecting a higher temperature may cause the air flow to diminish at the wound site until temperature equilibrium is restored.

Service and maintenance staff

2.20 The personnel charged with operating the plant should be trained in its operation and any special maintenance activities demonstrated.

2.21 Training in the correct operation and routine maintenance of the equipment will be provided as part of the handover procedure at the end of the commissioning period.

2.22 The training will need to be repeated periodically thereafter in order to cater for changes in staff.

2.23 Records of the training provided should be kept.

3. Minimum standards

General

3.1 New ventilation systems should be designed, installed, their performance validated and handed over to the standards set out in the relevant sections of this SHTM, Health Building Notes, Scottish Hospital Planning Notes and associated activity data sheets.

3.2 Existing ventilation systems may have been designed and installed to a different standard.

3.3 All ventilation systems installed in healthcare premises should be surveyed to ensure that the minimum standards set out below are achieved.

3.4 If the minimum standards set out below cannot be achieved then the frequency of monitoring and routine maintenance should reflect any resulting increase of risk to the health of those that the system serves.

Safety

3.5 Access to areas that contain ventilation plant should be secured to prevent unauthorised entry.

3.6 A safe means of access so that service and maintenance operations can be carried out should be provided.

3.7 Plant located outside on roofs should be provided with designated “walk ways” to protect the roof surface. A parapet, barrier or suitable alternative method of guarding the roof edge should be provided.

3.8 On tall buildings staff engaged in service and maintenance tasks may need protection from the effects of high winds. This may include windshields and clip-on safety harnesses.

3.9 Staff carrying out maintenance of plant located on the roof of a building will need to be reminded of the danger to pedestrians at ground level from tools, spares, access panels, etc. being blown from or rolling off the roof.

3.10 The risks arising from the service and maintenance of plant located outside on roofs will need to be formally assessed and suitable systems of work agreed. In extreme cases a permit-to-work system may be appropriate.

3.11 Access to plant located within roof spaces should be safe, permanent, well-illuminated and secure. The use of portable ladders to gain access is deprecated.

3.12 Plant rooms containing ventilation equipment should be well-illuminated and should permit safe access to all parts of the plant requiring inspection, service and maintenance.

3.13 Equipment that requires regular inspection should not need to have its covers removed but should be arranged such that visual inspection can be easily carried out. The provision of viewing ports and illumination within the duct will facilitate this approach.

Plant and equipment

Intakes and discharges

3.14 Badly sited air-intakes and discharges can cause contaminated air to be passed from one system to another. Portable smoke generators or smoke bombs may be helpful in visualising the discharge plume and will assist in assessing the potential risk

NOTE: Wind conditions will vary from day to day and sufficient tests to provide a representative sample will be necessary. The tests should be repeated with all of the possible combinations of fans both on and off.

3.15 Intakes and discharges should be protected to prevent rainwater entering the system. As far as it is practical they should be self draining. If they are not they must be fitted with a drainage system as detailed below (3.39 to 3.50).

Ducts and pipework

3.16 All ductwork should be marked in order to identify its purpose and direction of air flow. This will be particularly important in the case of fume cupboard and safety cabinet extract ducting. In these cases the ductwork should be marked along its complete length right up to the discharge point. It should also have chemical, biological or radiation hazard warning signs as appropriate.

3.17 Pipework should also be marked in order to identify clearly its contents and flow direction.

3.18 The location of fire dampers should be marked on the ductwork and at a visible point on the building fabric if the ductwork is concealed.

Cooling coils

3.19 Cooling coils fed with piped chilled water are the preferred option. If a multi-stage direct expansion cooling coil with refrigerant piped from an adjacent compressor/condensing plant is installed, a refrigerant gas detector mounted in the duct and an alarm system audible to the user may need to be provided to meet the Control of Substances Hazardous to Health (COSHH) Regulations.

3.20 All cooling coils will need to be provided with an eliminator and drainage system. The eliminator may be an extension of the coil fins or a separate device. A baffle or similar device must be provided in the drip tray to prevent air by-passing the coil and the tray should be large enough to capture the moisture from the return bends and headers.

Humidifiers

3.21 Steam humidifiers are the preferred option for use in ventilation systems serving healthcare premises. Micro-organisms often multiply in the supply pipework of water humidifying apparatus. Humidifiers that recirculate water must not be used.

3.22 Careful siting of the humidifier lance is required to prevent the steam impinging onto the side(s) of the duct, condensing and generating excess moisture. It is essential to position the humidifier upstream of the final attentuator.

3.23 All parts of the humidifier and its associated ductwork in contact with moisture should be manufactured from or treated with corrosion resistant materials. Stainless steel, GRP or plastic finishes are preferred.

3.24 On system shut-down, low air flow or fan failure, the humidifier control must isolate the appliance.

3.25 The cleanliness of the water supply and the effectiveness of any water treatment regimen should be regularly checked to a procedure agreed by the infection control team. The addition of treatment chemicals for continuous control of water quality for humidifiers/air handling units should be avoided. Consideration could be given to installing a UV system to control microbiological growth. UV systems however rely on high quality filtration to ensure the effective exposure of micro-organisms to the UV irradiation. The performance of the filter and the UV detection system should be regularly checked.

3.26 All humidifiers must be fitted with their own independent drainage system as detailed below.

3.27 The steam supply to a mains steam humidifier should be free of contaminants. Clean dry steam from the hospital boiler-plant may be used provided that the boiler water treatment complies with the Federal Drug Administration (FDA) Regulation 21: Part 173.310, **and also excludes**

volatiles. A warning notice regarding water treatment must be prominently displayed in the boilerhouse stating that the steam is to be used for humidification in the hospital air-conditioning plant and that only the approved additives may be used.

NOTE: Reference should also be made to the guidance contained in SHTM 2031; *Clean steam for sterilization*.

3.28 A mains steam humidifier can be noisy and will be difficult to control if it is operated at an excessive steam pressure. They are normally sized to operate at approximately 1 bar.

3.29 The steam pipework supplying it should be provided with a dirt pocket, pressure relief valve (PRV) and steam trap installed as close as practicable to the humidifier, so that the steam condition at entry is as dry as possible. A temperature switch on the condensate line or equivalent design provision by the humidifier manufacturer may be incorporated to prevent “spitting” on start-up.

3.30 Most operational problems with mains steam humidifiers arise because of back pressure in the condensate discharge line. Unless the condensate from the device can be discharged and collected at atmospheric pressure it should be discharged directly to drain.

3.31 Self-generating steam humidifiers may be used as an alternative. The location of the steam generator is critical if condensate is to drain back into it.

3.32 The steam generator must be fed with potable quality water. Additional water treatment to the standard set out above for mains steam humidifiers may be required. If the humidifier is not to be used for an appreciable time it must automatically drain its water content, including that contained in the supply pipework, back to the running main and remain dry.

3.33 Some generators are of a type that require regular cleaning and descaling. The design must allow for them to be installed such that they can be physically isolated from the air duct in order to prevent contamination of the air supply by cleaning agents while this is taking place.

3.34 Internal surfaces likely to be wetted should be regularly inspected. In the event of fouling, specialist cleaning may be necessary.

3.35 Providing the water supply is suitable, existing spinning disc humidifiers may be retained in service. Spinning disc humidifiers are known to present a considerable risk of causing humidifier fever once contaminated, and are required to be kept clean and well maintained.

3.36 The frequencies utilised in ultra-sonic humidifiers cannot be considered as effective for the control of micro-organisms. The supply of water to the

humidifier should be free from viable bacteria. Regular inspection and cleaning is required.

3.37 There should be a clear statement of the microbiological and chemical COSHH assessment of the operation of all humidifiers, water treatment regimens and monitoring procedures.

3.38 The procedures should be detailed in both the operating and maintenance manuals produced for each plant.

Drainage

3.39 All items of plant that could produce moisture must be provided with a drainage system. The system will comprise:

a. a drip-tray large enough to capture all of the moisture produced by the equipment;

b. a water seal; borosilicate glass trap, twice the fan static pressure deep so that its seal is not blown out at fan start-up;

c. continuously falling drainage pipework to remove the moisture;

d. an air break to ensure that once the moisture has been discharged to drain, it cannot return to the plant.

3.40 The drip-tray should be constructed of a corrosion resistant material and be so arranged that it will completely drain. To prevent “pooling” it is essential that the drain connection should not have an upstand, and a slope of approximately 1:20 in all directions should be incorporated to the drain outlet position. The tray must be easily removable for inspection and maintenance.

3.41 The trap need not be directly under the drainage tray provided that the pipework connecting the two has a continuous fall. Each trap should be of the clear (borosilicate) glass type to show (visibly) the integrity of the water seal, and should be provided with a means for filling. A permanent marker on each trap should be provided to indicate the water seal level when the system fan is running at its design duty. Each installation should incorporate quick release couplings to facilitate removal of the traps for cleaning.

3.42 Traps fitted to plant located outside or in unheated plant rooms may need to be trace heated in winter. The trace heating must not raise the temperature of water in the trap above 5°C.

3.43 Pipework from each trap outlet should be thermoplastic, copper or stainless steel tube. Stainless steel could be particularly useful in situations requiring mechanical strength (glass is not necessary). The pipework should have a minimum fall of 1 in 60 in the direction of flow and be well-supported.

3.44 Water from each trap must discharge via a type A air gap, as specified in BS 6281: Part 1, 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).

3.45 Individual drainage systems should be completely separate right up to and including the airbreak.

3.46 The possibility of local plantroom flooding during drainage operations on other equipment or ponding on flat roofs when plant is mounted outside, should be borne in mind when locating the airbreak.

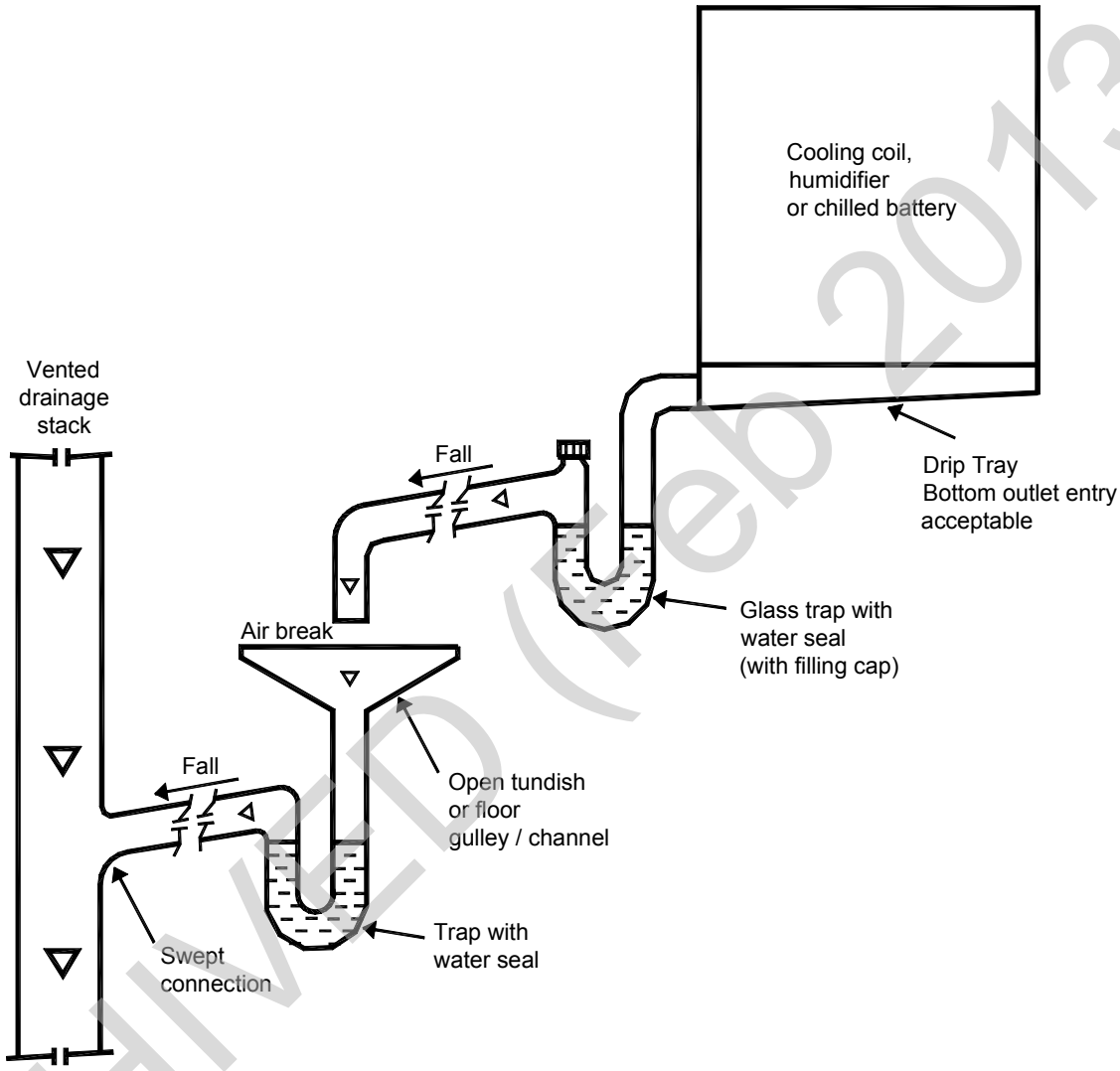
3.47 It may be necessary to use chlorine or other chemicals to decontaminate humidifiers/cooling coils, etc. during routine maintenance operations. The plant drains should therefore discharge into the foul drainage system. The surface water drainage system may be used, for example, when a plant is installed on the roof, but if chemicals are used during cleaning operations it will be necessary to discharge the effluent to the foul drainage system, for example, by use of a hose.

3.48 Where the drainage pipework from the tundish outlet, which should be ventilated, discharges into a surface water drainage stack or a dedicated plant drainage stack, the connection shall be via an easy swept tee.

3.49 An example of a complete drainage system is shown in Figure 1.

3.50 Drainage traps should be routinely checked to ensure that the water level is correct and cleaned as necessary.

Figure 1: Typical air-conditioning plant drain



4. Performance monitoring

General

4.1 The performance of ventilation systems should be monitored on a continuing basis. Monitoring of the conditions at the point of use will generally be carried out by the user, and that of the main plant and equipment by the service and maintenance staff. There may however be considerable overlap in these duties particularly in the case of laboratory and LEV systems. Agreement should be reached, between the user and those managing the maintenance of the system, as to exactly who will assume responsibility for each aspect of the performance monitoring. It is preferable to arrange testing by an independent organisation.

4.2 Those appointed should be competent to carry out their duties and be provided with the necessary facilities and training.

User

4.3 Any apparent fall in the standard being achieved should be reported to the manager responsible for the safe operation of the plant.

4.4 Plants provided to meet a statutory requirement may be subject to daily, weekly, monthly, quarterly, bi-annual and/or annual performance monitoring by their user. The results would need to be entered into a log system and preserved for future inspection.

4.5 Some specialised ventilation applications require that the user is provided with a continuous indication that the plant is operating within safe limits. In its simplest form this may be achieved by fitting a simple floating ball indicator, the height of the ball being an indication that air flow exists and its approximate rate.

4.6 LEV plants provided to comply with the requirements of the COSHH regulations will need to be monitored by their users on a daily basis with a visual inspection of the equipment at least weekly or at a frequency commensurate with the hazard arising from plant failure. Records of these inspections must be kept.

4.7 The operation of safety cabinets should be monitored on either a daily or “as used” basis. The air flow at the working face must be measured weekly as set out in BS EN 12469; Biotechnology Performance Criteria for Microbiological Safety Cabinets, and the results recorded.

Service and maintenance staff

4.8 Regular inspections of ventilation plants and equipment should be undertaken. Their purpose will be to monitor the safe operation and provide information as to the scale and frequency of routine maintenance. They would typically consist of a visual inspection of the items listed under the headings below.

General

4.9 Ensure that:

a. plant is secure from unauthorised access;
b. access is safe to all parts requiring inspection;
c. the area around the plant is free of rubbish;
d. all access doors and panels are secure;
e. internally, the plant is clean and free of visible moisture.

Air intake and discharge

4.10 Ensure that:

a. they are clear of vegetation and rubbish;
b. louvres are clean and insect/vermin screens are clear;
c. automatic isolation dampers are free to operate.

Fog/frost coil

4.11 Ensure that:

a. coil is clean;
b. off coil temperature is at a safe minimum.

Fans

4.12 Ensure that:

a. noise and vibration are within acceptable limits;
b. drive arrangement and bearings are satisfactory;
c. motor is at a safe temperature.

Filters

4.13 Ensure that:

a. the filters are visibly examined for condition and are intact;
b. manometer readings are between preset limits;
c. inspection lights are operating.

Drainage systems

4.14 Ensure that:

a. water level in the trap is between marks;
b. water in the trap is clean;
c. air break dimensions are correct;
d. pipework is supported so that the air break dimensions cannot be reduced;
e. drain-tray is clean, free from standing water, corrosion and mould growths;
f. inspection lights are operating.

Heater/chiller batteries

4.15 Ensure that:

a. fins and tubes are clear;
b. condensate is discharging satisfactorily;
c. cooling coil drainage system is satisfactory (see paragraph 4.14 above);
d. inspection lights are operating.

Humidifiers

4.16 Ensure that:

a. steam supply pressure is within preset limits;
b. no evidence of “wetting out” on the adjacent ductwork;
c. condensate is discharging satisfactorily;
d. drainage system is satisfactory (see paragraph 4.14 above);
e. inspection lights are operating.

Energy recovery devices

4.17 Ensure that:

a. air side of the device is free of fluff;

b. drainage system is satisfactory (see paragraph 4.14 above).

Control systems

4.18 Ensure that:

a. sensors are in position, connected and clean;

b. control valves and actuators are connected and free of visible leaks;

c. control valves in the “off” position are not passing.

4.19 The above list is only intended as a guide, and should be extended or reduced to suit the particular plant.

4.20 The actual frequency of monitoring should be commensurate with the hazards arising from plant failure or faulty operation. A monthly visual inspection would be the recommended minimum; for high risk plants a weekly inspection may be more appropriate.

4.21 The keeping of excessively detailed records of inspections is not considered necessary. A simple checklist with room for comments will normally suffice. Appendix 2 contains an example.

5. Routine maintenance

General

5.1 All ventilation systems should be subjected to an inspection, service and maintenance scheme at least every half year.

5.2 The maintenance scheme should be drawn up paying particular attention to the function of the system and the hazards arising through plant failure.

5.3 Maintenance schemes should consist of the following:

a. a visual inspection to determine the condition of the plant;

b. cleaning of all parts of the system that handle unfiltered air. This would include air intakes and extract grilles;

c. disinfection of all sections that are known to become damp in normal use. The procedure is set out in Appendix 1;

d. sufficient measurements of the plant's performance to determine its continuing ability to perform its designated function. Liaison with the end user should take place to seek their views on the overall performance of the system;

e. an electrical safety check of the plant and its associated subsystems;

f. a functional test of all safety devices and limit controls.

Appendix 3 contains an example of a checklist for the half-yearly inspection, service and maintenance of a typical ventilation system.

5.4 An annual review of the operation of the plant should be undertaken. The review should address:

a. the overall condition of the plant;

b. the reasons for signs of corrosion;

c. the suitability of the filters and their grades;

d. possible sources of contamination in the vicinity of the air intake;

e. possible problems arising from the position of the extract air discharge;

f. the appropriateness of the specific plant operating instructions and safe systems of work;

g. the management system that ensures that the standards agreed for the operation and maintenance of the plant are being maintained.

The conclusions drawn and any action taken should be recorded and the systems operating procedures amended to suit.

5.5 Air-conditioning and ventilation plant and its ductwork should be inspected at the access point(s) annually to see that it is clean and to monitor its general condition. After several years in service, even in the case of a correctly filtered plant, there may be signs of dirt accumulation and consideration should be given to cleaning the system.

5.6 Accumulation of dirt in a relatively short period is indicative of either a failure of the filtration system or that the wrong grade of filters are being used. In particularly polluted areas it may be appropriate to consider the installation of a higher grade of final filter and pre-filter. The quality of filter housing and in particular their seals is a critical factor in maintaining the efficacy of the filtration system by ensuring that air does not bypass the filters.

5.7 BS 5588 states that fire dampers should be tested every two years but many fire authorities request that they are tested annually and the results recorded in a log book.

Ultra-clean ventilation systems

5.8 The air velocity from the ultra clean terminal should be measured annually using the method set out in paragraph 5.2 of the *Validation and verification* part of this SHTM.

5.9 Bacteriological sampling should also be carried out annually using the method set out in paragraph 5.36 of the *Validation and verification* part of this SHTM.

5.10 UCV terminals failing the bacteriological test should be subjected to a filter challenge using the method set out in paragraph 5.26 and 5.27 of the 'Validation and verification' part of this SHTM. They should then be re-tested bacteriologically.

5.11 The above tests will also need to be carried out following a high efficiency particulate air (HEPA) filter change, on completion of any work that could have disturbed the UCV terminal or if ever doubt exists as to the quality of the air being delivered.

Local cooling/refrigeration units

5.12 This type of equipment, often known as a "cassette" or "split system", is usually self-contained and located in the room that it serves. Units may be ceiling or floor-mounted with their heat rejection section mounted on an outside wall/roof.

5.13 Routine maintenance would consist of filter cleaning/changing, coil cleaning and an inspection of the drainage arrangements. The drain tray should be inspected and cleaned quarterly.

5.14 The heat rejection section, mounted remotely, should be inspected annually to ensure that the condenser coil is clean and that the refrigerant charge is sufficient and free from moisture.

Portable dehumidifiers and room air-conditioners

5.15 These units are normally used to provide a **temporary** solution to a problem of high humidity or excessive temperature. They may also be required in order to maintain a specific air condition for medical reasons. They should be removed as soon as the original need for them has passed.

5.16 The complete unit should be thoroughly inspected for electrical safety, cleaned and disinfected each time it is taken into use. While in use the unit should be inspected, cleaned and disinfected at monthly intervals.

5.17 Portable dehumidifiers and room air-conditioners usually incorporate a reservoir to contain the condensate produced. This should be emptied by the user frequently.

Local exhaust ventilation (LEV) systems

5.18 LEV systems are used to protect personnel from chemical, gaseous, biological and general dust hazards. They are designed to capture the pollutant at source and discharge it safely. The following are typical examples of LEV applications:

- laboratory fume cupboards;
- pharmacy safety cabinets including cytotoxic and radio-pharmacy cabinets;
- pathology microbiological safety cabinets, formaldehyde mixing and specimen preparation bays;
- glutaraldehyde mobile cabinets and workstations;
- dental grinders, buffers, casting machines, sand blasters and plating baths;
- X-ray and photographic film processing units;
- mortuary bone saws, dissection tables and specimen bench extracts;
- EBME equipment decontamination units;
- fixed and mobile welding bay fume extract equipment;
- battery charging bay extracts;
- chemical decanting bays;
- paint spray booths;
- woodworking machinery dust control systems;

- general dust extract systems.

5.19 All LEV systems must be subjected to a thorough examination and test at least every 14 months. HS(G)54: *The Maintenance, Examination and Testing of Local Exhaust Ventilation* published by the Health and Safety Executive gives guidance on the standards required. The examination and test should be carried out by an independent organisation and the results compared with the original commissioning tests.

5.20 A safety officer who is familiar with the effects of the process being contained by the LEV should be designated and whose advice sought before changing filters or undertaking work of any kind. Decontamination of the system may be necessary; if this is the case then a permit-to-work system should be in operation.

5.21 Dirty extract filters will contain contamination and as such should be treated as classified waste.

5.22 Some LEV systems, such as safety cabinets and fume cupboards, are subject to their own specific guidance documents

Microbiological safety cabinets

5.23 Safety cabinets must be subjected to a thorough examination and test at least every 14 months using the methods set out in BS EN 12469. When used for certain applications they may need to be examined and tested every six months.

5.24 Before changing filters or undertaking work of any kind on the cabinet or its associated extract system it must be decontaminated. BS 5726:Part 4: Section 4 gives details of suitable methods. A permit-to-work system should be in operation, a specimen is shown in Appendix 4.

5.25 Dirty extract filters will contain contamination and as such should be treated as classified waste.

5.26 Prior to returning the cabinet to service, the complete installation must be tested using the method set out in BS EN 12469: 2000 – 'Biotechnology. Performance criteria for microbiological safety cabinets'.

Laboratory fume cupboards

5.27 Laboratory fume cupboards must be subjected to a thorough examination and test at least every 14 months using the methods set out in BS 7258: Part 3: Section 5. This section also sets out the six monthly and twelve monthly maintenance procedures. If the cupboard is frequently used for substantial quantities of corrosive chemicals the maintenance intervals should be reduced to one month and six months respectively.

5.28 Before changing filters or undertaking work of any kind on the cabinet or its associated extract system it may need to be decontaminated. If this is the case then a permit-to-work system should be in operation. The advice of the designated laboratory safety officer should be sought before commencing work.

5.29 Dirty extract filters will contain contamination and as such should be treated as classified waste.

Glutaraldehyde mobile cabinets and workstations

5.30 Glutaraldehyde cabinets and workstations must be subjected to a thorough examination and test at least every 14 months. Further guidance is contained in SHTM 2030; *Washer Disinfectors*.

5.31 Before changing filters or undertaking work of any kind on the cabinet or its associated extract system it will need to be decontaminated. A permit-to-work system should be in operation. The advice of the designated safety officer should be sought before commencing work.

5.32 Dirty extract filters will be contaminated and as such should be treated as classified waste.

6. Records

Designated staff functions

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

6.2 **Management** - management is defined as the owner, occupier, employer, chief executive or other person who is ultimately accountable for the safe operation of premises.

6.3 **Authorised person** - a person appointed or contracted by the chief executive to review and witness documentation on validation and provide auditing and advice on ventilation installations and their application.

6.4 **Test person** - a person or organisation contracted by the chief executive to carry out commissioning, validation and routine testing of ventilation installations.

6.5 **Maintenance person** - a member of the maintenance staff, ventilation equipment manufacturer or maintenance organisation employed by the general manager to carry out maintenance duties on ventilation installations.

6.6 **Infection control officer** - or consultant microbiologist, if not the same person, nominated by the management to advise on monitoring infection control policy and microbiological performance of the systems. Major policy decisions should be made through an infection control committee.

6.7 **Plant operator** - any person who operates a ventilation installation.

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

6.9 **Contractor** - the person or organisation responsible for the supply of the ventilation equipment, its installation, commissioning and validation. This person may be a representative of a specialist ventilation organisation or a member of the general manager/chief executive's staff.

6.10 A record should be kept of those appointed to carry out the staff functions listed above. The record should clearly state the extent of the post holder's duties and responsibilities and to whom they are to report.

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

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

Service and maintenance

6.13 A record should be kept for each ventilation system of the following:

a. routine inspections;
b. routine maintenance;
c. breakdowns and unscheduled service and maintenance activities;
d. refurbishment, additions and alterations;
e. changes in the control strategy;
f. fire damper tests;
g. disinfection of equipment;
h. decontamination of the system;
i. filter changes;
j. the results of any test carried out on the system.

For simple ventilation systems these records may take the form of the inspection and maintenance checklists.

6.14 Specialised systems, LEV systems and safety cabinets will require more detailed records. These could include copies of manufacturer's test data, the results of the validation and verification exercise, an inspection log book, maintenance job cards, recommissioning test results and performance monitoring data. There is a statutory requirement to maintain records for these types of systems.

6.15 The records will need to be kept for at least five years and should be available for inspection at any time.

Appendix 1

Disinfection procedure

Prior to taking a plant into use or at Intervals not exceeding six months, all parts of the plant that become damp in normal use shall be disinfected following the procedure given below. This will include humidifiers, cooler batteries/cooling coils, drainage systems and energy recovery devices. Those carrying out the procedure shall produce dated certification of its completion (see below). The disinfection procedure is given below:

a. all procedures must comply with the Health and Safety at Work etc Act and COSHH regulations;

b. notify all persons working in those areas served by the plant to be disinfected;

c. switch off all ventilation systems containing the devices to be disinfected;

d. close the plant isolating dampers,

e. open and remove the inspection covers/access doors on both sides of the devices;

f. spray all internal surfaces of the humidifier section or cooler battery/cooling coil with a 5 ppm chlorine solution until all surfaces are thoroughly wetted, also flood drip- trays and drainage system with the same solution and allow to stand for a minimum of two hours;

g. spray all Internal surfaces of the humidifier and cooler battery/cooling coil with sufficient clean water to remove all traces of the chlorine solution from the device, its drip tray and drainage system;

h. restore the plant to normal operation;

i. if any suspicion arises as to the possible contamination of the system then the microbiologist should be requested to take swab tests from all drain trays and cooler battery/cooling coil tubes and fins;

j. **as an alternative to steps (f) and (g) detailed above, the surfaces may be steam cleaned;**

k. a record must be kept of who carried out the disinfection when it was completed and the method used.

Appendix 2

An example of a typical air-conditioning plant regular monitoring checklist

Date of inspection:……..

Plant identification code and/or location:…….

Plant item	Inspect	Satisfactory Yes	No
Air-intake	Area clear of rubbish Louvre unobstructed Mesh screen clean Duct free of water		
Intake damper	In correct position (for example): Plant on – Open Plant off – Closed		
Frost coil	Off coil temp at least 2°C		
Primary filter	Visual inspection Pressure drop within limits Actual manometers reading Pa:		
Supply fan(s)	Correct number operating (for example): Normal – 2 Set–back – 1 Plant off – 0 Vibration Motor temperature Drive		
Chiller	Drainage system: Water seal Air break		
Humidifier	Discharging dry steam Duct free of moisture Drainage system: Water seal Air break		
Secondary filter	Visual inspection Pressure drop within limits Actual manometer reading Pa:_____		
Control state		On	Off
	Frost coil Energy recovery device Chiller battery Main heater battery Humidifier Terminal heater battery		
Terminal filter	Visual inspection Pressure drop within limits Actual manometer reading Pa:		

Plant item	Inspect	Satisfactory Yes	No
Extract fan(s)	Correct number operating (for example): Normal – 1 Set-back-0 or ½ speed Plant off – 0 Vibration Motor temperature Drive		
Energy recovery device	Supply side Drainage system: Water seal Air break Extract side Drainage system: Water seal Air break		
Extract damper	In correct position (for example): Plant on – Open Plant off - Closed		
Air discharge	Area clear of rubbish Louvre unobstructed Mesh screen clean Duct free of water		
Plant location	Secure Accessible Lighting Clean and free of rubbish		
Specific comments:			

Signed: Inspector:_____ Date: _____

Remedial action proposed:

Supervising manager:_____ Date:_____

Appendix 3

An example of a typical air-conditioning plant half-yearly inspection

Date of inspection:

Plant identification code and/or location:

Plant item	Inspect, service and maintain	Satisfactory Yes	Satisfactory No
Air intake and discharge	Louvre: Clear surrounding area of vegetation, rubbish, etc. Check for possible sources of contamination and eliminate. Mesh screen: Inspect, repair, clean Duct work: Inspect for sign that moisture has been present, investigate, repair take remedial action to prevent recurrence.		
Plant isolating dampers	Clean blades Lubricate linkage Prove operation		
Viewing ports, access doors, access panels and duct lights	Inspect seals Check clamping arrangements Clean glass Electrical safety check Prove operation		
Filters	Housing: Inspect seals Check clamping arrangements Filters: Inspect for damage Assess service life from regular monitoring information Assess effectiveness/suitability of grade Manometers: Check fluid level Check that clean/dirt filter pressure drop is indicated and correct for filter fitted		
Attenuators	Inspect for signs of “fill” deterioration Clean and measure pressure drop. Compare with previously recorded value		

Plant item	Inspect, service and maintain	Satisfactory Yes	Satisfactory No
Fans	Fan blades and casing: Inspect, clean, check balance Check condition of flexible duct connections Drive arrangement: Inspect for play, slip, alignment wear Lubricate bearings Check guards are adequate Motors: Electrical safety check Inspect, clean, lubricate Check holding down bolts and position adjustment Dynamic tests; measure: Rotational speed fan Rotational speed motor Current drawn per phase Inlet pressure Outlet pressure Volumetric air flow delivered at operating conditions (Repeat the above at alternative operating speeds if appropriate)		
Frost coils and heater batteries	Inspect and clean Check sensor calibration Prove operation of control		
Cooling coils and energy recovery devices	Inspect coils Disinfect by steam cleaning or chlorination		
Humidifiers	Inspect steam supply, PRV, strainers and main steam line trapping arrangements Check that steam supply still meets quality standards and that warning notices of permissible water treatments are clearly displayed in boilerhouse Check condensate drainage arrangements including traps and strainers Inspect humidifier valve plug and seat – clean or replace Check steam pressure to device is as specified Check sensor calibration both high limit and normal operating Prove operation of control		
Drainage systems	Remove and inspect drip-trays for signs that moisture has been present, investigate and take remedial action to prevent recurrence Remove water seal trap, disinfect, refit and refill Check pipework supports Measure air break and compare with design dimensions Prove the operating of the drainage system by introducing clean water into the drain tray and observing it drain away completely		

Plant item	Inspect, service and maintain	Satisfactory Yes	Satisfactory No
Fire dampers	Check access Check location is identifiable Inspect mounting frame Check sensor/detector Inspect, prove operation and reset		
Air distribution system	Distribution ductwork: Inspect for leakage, corrosion and dirt Balancing dampers: Check that they have not been tampered with and are locked in position Supply terminal devices: Check terminal volume control is locked Check air direction distribution device is correctly set Balance flaps, transfer grilles, etc: Inspect and clean Check operation Extract terminal devices: Check identification Check volume control device is locked Remove, clean, inspect and replace Dynamic tests, measure: Volumetric air flow at randomly selected supply and extract terminal devices Pressure differential between “key” rooms Record results and compare with original commissioning information		
Controls	Electrical safety check Inspect valve plug and seat, clean or replace Lubricate linkages Prove operation Compare system operation with control algorithm		
Plant location	Check security of plant from unauthorised access or operation Inspect safety of means of access Electrical safety check for all plant room systems Check all plant systems are correctly identified Prove lighting operates Inspect and clean location		

Specific comments:

Signed: Inspector:_____ Date: _____

Remedial action proposed:

Supervising manager:_____ Date: _____

Appendix 4

Specimen permit-to-work system for microbiological safety cabinets

Document Serial No……

MICROBIOLOGICAL SAFETY CABINET MAINTENANCE

……Laboratory……Hospital

…… ……

cabinet class…… manufacturer/supplier……

hospital serial No…… .manufacturer's serial No……

WORK TO BE CARRIED OUT

……

……

work requested by……..position……date……..

request approved……...position……date……..

NO OTHER WORK SHALL BE CARRIED OUT

DISINFECTION

The following are to be disinfected:-

cabinet carcass and filters ☐ * exhaust ducting and fan ☐ *

method of disinfection……..

……

details of disinfection:-date/time started……..date/time completed……...

I CERTIFY THAT THE ABOVE DISINFECTION PROCEEDURE HAS BEEN SATISFACTORILY CARRIED OUT AND THAT THE WORK REQUESTED ABOVE MAY BE UNDERTAKEN

Signed…….. position…….. date……

WORK CARRIED OUT

……..

……..

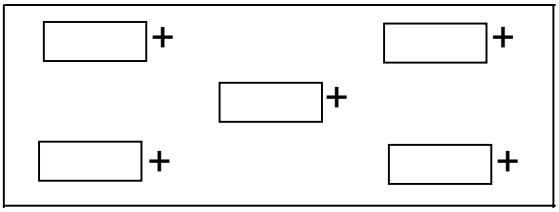
work carried out by……position……date……..

COMPLETION TESTS

gaskets and seals satisfactory around filters ☐ * door and windows ☐ *

filter efficiency test method……result ☐ +

cabinet working aperture air velocities at positions indicated in……+……..(Units)



CERTIFICATION

I CERTIFY THAT THE ABOVE WORK AND COMPLETION TESTS HAVE BEEN SATISFACTORILY CARRIED OUT AND THAT THE MICROBIOLOGICAL SAFETY CABINET MAY BE RETURNED TO SERVICE

signed……position……..date……

Certification and request approval should be signed by the Laboratory Safety Officer, Consultant Microbiologist, or person holding similar office.

* Initial boxes as required + Insert figures obtained in

COPIES ORIGINAL to person carrying out work: on completion file in cabinet log book.
DUPLICATE to Laboratory Safety Officer or person holding similar office.
TRIPLICATE to be retained in book.

Appendix 5: Abbreviations

BS	British Standard
COSHH	Control of Substances Hazardous to Health
HMSO	Her Majesty's Stationery Office
HSW	Health and Safety at Work
LEV	Local exhaust ventilation
NHS	National Health Service
P&EF	Property and Environment Forum
SHPN	Scottish Health Planning Note
SHTM	Scottish Health Technical Memorandum
SHTN	Scottish Health Technical Note
SI	Statutory Instrument
WRc	Water Research Centre

References

NOTE:
Where there is a requirement to address a listed reference, care should be taken to ensure that all amendments following the date of issue are included.

Publication ID	*Title*	*Publisher*	*Date*	*Notes*
Acts and Regulations				
	The Building (Scotland) Act	HMSO	1959	
	Clean Air Act	HMSO	1993	
	Electricity Act	HMSO	1989	
	Health and Safety at Work etc Act	HMSO	1974	
	Registered Establishments (Scotland) Act	HMSO	1998	
	The Water (Scotland) Act	HMSO	1980	
SI 2179 & 187	The Building Standards (Scotland) Regulations (as amended)	HMSO	1990	
	The Building Standards (Scotland) Regulations: Technical Standards Guidance	HMSO	1998	
SI 1460	Chemicals (Hazard Information and Packaging for Supply) Regulations (CHIP2)	HMSO	1997	
SI 3140	Construction (Design and Management) Regulations	HMSO	1994	
SI 437	Control of Substances Hazardous to Health Regulations (COSHH)	HMSO	1999	
SI 635	Electricity at Work Regulations	HMSO	1989	
SI 1057	Electricity Supply Regulations (as amended)	HMSO	1988 (amd 1994)	
SI 2372	Electromagnetic Compatibility Regulations (as amended)	HMSO	1992	
SI 2451	Gas Safety (Installation and Use) Regulations	HMSO	1998	
SI 917	Health & Safety (First Aid) Regulations	HMSO	1981	
SI 682	Health & Safety (Information for Employees) Regulations	HMSO	1989	
SI 2115	Control of Asbestos at Work Regulations (as amended)	HMSO	1987	
SI 1713	Confined Space Regulations	HMSO	1997	

Publication ID	Title	Publisher	Date	Notes
SI 2792	Health and Safety (Display Screen Equipment) Regulations	HMSO	1992	
SI 341	Health and Safety (Safety Signs and Signals) Regulations	HMSO	1996	
SI 1380	Health and Safety (Training for Employment) Regulations	HMSO	1990	
	Highly Flammable Liquids and Liquefied Petroleum Gases Regulations	HMSO	1972	
SI 2307	Lifting Operations and Lifting Equipment Regulations (LOLER)	HMSO	1998	
SI 3242	Management of Health and Safety at Work Regulations	HMSO	1999	
SI 2793	Manual Handling Operations Regulations	HMSO	1992	
SI 1790	Noise at Work Regulations	HMSO	1989	
SI 3139	Personal Protective Equipment (EC Directive) Regulations (as amended)	HMSO	1992	
SI 2966	Personal Protective Equipment at Work (PPE) Regulations	HMSO	1992	
SI 128	Pressure Systems Safety Regulations (PSSR)	HMSO	2000	
SI 2306	Provision and Use of Work Equipment Regulations (PUWER)	HMSO	1998	
SI 3163	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR)	HMSO	1995	
SI 3004	Workplace (Health, Safety and Welfare) Regulations	HMSO	1992	
British Standards				
BS 349	**Specification for identification of the contents of industrial gas containers** (AMD 6132, 5189)	BSI Standards	1973	
BS 1319	**Specification for medical gas cylinders, valves and yoke connections** (AMD 3029, 6179, 4603, 6184)	BSI Standards	1976	
BS 5378	**Safety signs and colours**	BSI Standards		
BS 5499	**Fire safety signs and graphic symbols**	BSI Standards		
BS 5266	**Code of practice for emergency lightning**	BSI Standards	1988	
BS 8313	**Code of practice for accommodations of building services in duct**	BSI Standards	1997	

Publication ID	Title	Publisher	Date	Notes
Scottish Health Technical Guidance				
SHTM 2007	Electrical services supply and distribution	P&EFEx	2001	CD-ROM
SHTM 2010	Sterilization	P&EFEx	2001	CD-ROM
SHTM 2011	Emergency electrical services	P&EFEx	2001	CD-ROM
SHTM 2014	Abatement of electrical interference	P&EFEx	2001	CD-ROM
SHTM 2020	Electrical safety code for low voltage systems (Escode – LV)	P&EFEx	2001	CD-ROM
SHTM 2021	Electrical safety code for high voltage systems (Escode – HV)	P&EFEx	2001	CD-ROM
SHTM 2022	Medical gas pipeline systems	P&EFEx	2001	CD-ROM
SHTM 2024	Lifts	P&EFEx	2001	CD-ROM
SHTM 2025	Ventilation in healthcare premises	P&EFEx	2001	CD-ROM
SHTM 2027	Hot and cold water supply, storage and main services	P&EFEx	2001	CD-ROM
SHTM 2045	Acoustics	P&EFEx	2001	CD-ROM
SHPN 1	Health service building in Scotland	HMSO	1991	
SHPN 2	Hospital briefing and operational policy	HMSO	1993	
SHTN 1	Post commissioning documentation for health buildings in Scotland	HMSO	1993	
SHTN 4	General Purposes Estates and Functions Model Safety Permit-to-Work Systems	EEF	1997	
	NHS in Scotland – PROCODE	P&EFEx	2001	Version 1.1
NHS in Scotland Firecode				
SHTM 81	Fire precautions in new hospitals	P&EFEx	1999	CD-ROM
SHTM 82	Alarm and detection systems	P&EFEx	1999	CD-ROM
SHTM 83	Fire safety in healthcare premises: general fire precautions	P&EFEx	1999	CD-ROM
SHTM 84	Fire safety in NHS residential care properties	P&EFEx	1999	CD-ROM
SHTM 85	Fire precautions in existing hospitals	P&EFEx	1999	CD-ROM
SHTM 86	Fire risk assessment in hospitals	P&EFEx	1999	CD-ROM
SHTM 87	Textiles and furniture	P&EFEx	1999	CD-ROM
SFPN 3	Escape bed lifts	P&EFEx	1999	CD-ROM
SFPN 4	Hospital main kitchens	P&EFEx	1999	CD-ROM

Publication ID	*Title*	*Publisher*	*Date*	*Notes*
SFPN 5	Commercial enterprises on hospital premises	P&EFEx	1999	CD-ROM
SFPN 6	Arson prevention and control in NHS healthcare premises	P&EFEx	1999	CD-ROM
SFPN 7	Fire precautions in patient hotels	P&EFEx	1999	CD-ROM
SFPN 10	Laboratories on hospital premises	P&EFEx	1999	CD-ROM
UK Health Technical Guidance				
EH 40	HSE Occupational Exposure limits	HSE	Annual	
MES	Model Engineering Specifications	NHS Estates	1997	As required
Approved code of practice	The Control of Asbestos at Work Regulations	HMSO	1987	
Approved code of practice	Work with Asbestos Insulation, Asbestos Coating and Asbestos Insulating Board	HMSO	1988	
HSE Publications				
CS 4	Keeping of LPG in cylinders and similar containers	HMSO	1986	
CS 5	Part 1: Entry into confined spaces Part 2: Cleaning and gas freeing of tanks containing flammable residues	HMSO	1977	
Miscellaneous References				
	Space allowances for building services distribution systems: detail design stage (TN 10/92)	Building Services Research and Information Association (BSRIA)	1992	
	The safe storage of gaseous hydrogen in seamless cylinders and similar containers (CP 8)	British Compressed Gases Association	1986	