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Health Building Note 04-01 Supplement 1: Special ventilated isolation facilities for patients in acute settings

Preface

About Health Building Notes

Health Building Notes (HBNs) give best practice guidance on the design and planning of new healthcare buildings and on the adaptation/extension of existing facilities.

They provide information to support the briefing and design processes for individual projects in the NHS building programme.

Language usage in technical guidance

In HTMs and HBNs, modal verbs such as "must", "should" and "may" are used to convey notions of obligation, recommendation or permission. The choice of modal verb will reflect the level of obligation needed to be compliant.

The following describes the implications and use of these modal verbs in HTMs/HBNs (readers should note that these meanings may differ from those of industry standards and legal documents):

- "Must" is used when indicating compliance with the law.
- "Should" is used to indicate a recommendation (not mandatory/ obligatory), i.e. among several possibilities or methods, one is recommended as being particularly suitable – without excluding other possibilities or methods.
- "May" is used for permission, i.e. to indicate a course of action permissible within the limits of the HBN or HTM.

Typical usage examples

- "Design teams must have due regard to the protected characteristics as defined in the Equality Act 2010." [obligation]
- "All clinical areas should have access to natural light." [recommendation]
- "Where it is not necessary to access both sides of the couch, the single-sided room layout may be used." [permission]

"Shall", in the obligatory sense of the word, is never used in current HTMs/HBNs.

Project derogations from the Technical Guidance

Healthcare facilities built for the NHS are expected to support the provision of high-quality healthcare and ensure the NHS Constitution right to a clean, safe and secure environment. It is therefore critical that they are designed and constructed to the highest and most appropriate technical standards and guidance. This applies when organisations, providers or commissioners invest in healthcare accommodation (irrespective of status, e.g. Foundation and non-Foundation trusts).

Statutory standards plus technical standards and guidance specific to NHS facilities:

- Health Building Notes
- Health Technical Memoranda

A complete list of NHS estates-related guidance can be found on the NHS England website.

The need to demonstrate a robust process for agreeing any derogation from Technical Guidance is a core component of the business case assurance process.

The starting point for all NHS healthcare projects at Project Initiation Document (PID) and/or Strategic Outline Case (SOC) stage is one of full compliance.

Derogations to standards will potentially jeopardise business case approval and will only be considered in exceptional circumstances. A schedule of derogations will be required for any project requiring external business case approval and may be requested for those that have gone through an internal approvals process.

While it is recognised that derogation is required in some cases, this must be risk-assessed and documented in order that it may be considered within the appraisal and approval process.

Derogations must be properly authorised by the project's senior responsible owner and informed and supported by appropriate technical advice (irrespective of a project's internal or external approval processes).

Sustainability and net zero carbon targets

The UK is leading the way on tackling climate change and improving sustainability, and the NHS is leading the way in England.

In 2019, the UK became the first major economy to commit to net zero emission by 2050. In 2020, the NHS set out its intent to support this ambition through its 'Delivering a "Net Zero" National Health Service' report. The report sets a clear target for achieving a net zero health service for direct emissions by 2040 and indirect emissions by 2045.

In 2021, NHS England published supporting guidance for the NHS Estate in its 'Estates Net Zero Carbon Delivery Plan', and further guidance is planned over the coming years.

The NHS estate has a critical role to play in achieving net zero carbon emissions. It is vital that every opportunity is seized across the NHS to do so, and the NHS estate is an area where direct and cost-effective action can be taken with a high degree of confidence.

This guidance is not mandatory (unless specifically stated). However, any departures/ derogations from this HBN – including the measures implemented – should provide a degree of safety not less than that achieved by following the guidance set out in this HBN.

Executive summary

This document is the 2024 revision of the supplement to Health Building Note 04-01 – 'Adult in-patient facilities' on special ventilated isolation facilities.

Special ventilated isolation suites utilise the supply and extract of air to create pressure differentials and move the air in a known direction, thus providing the desired degree of protection between neighbouring spaces from airborne pathogens and contaminants. The volume of air passing through will dilute airborne contaminants arising from the occupant and those who enter the suite.

In this revision, special ventilated isolation facilities consist of the patient's bedroom, lobby and en-suite.

Three possible modes of isolation from airborne pathogens or contaminants are covered:

a. **source isolation in a negative pressure suite**: patients and staff elsewhere in the hospital do not become exposed to harmful airborne pathogens or contaminants shed by the room occupant

b. **protective isolation in a positive pressure suite**: a patient occupying the room is protected from being exposed to harmful airborne pathogens or contaminants from elsewhere in the hospital or from the outside air

c. **combined source and protective isolation in a positive pressure ventilated lobby (PPVL) suite**: both the patient in the room and other patients and staff outside of the room are protected from harmful airborne pathogens or contaminants.

Ventilation schematics are provided for two configurations of each suite type:

- one that includes a bed access door through the lobby
- a second that features a bed access door directly through the patient's bedroom.

Room layout drawings are provided as a guide.

Main changes since the previous edition

- In previous editions of the Supplement, while a lobby was required for PPVL isolation suites, it remained optional for other types of ventilated isolation suites. However, this latest version recommends that a lobby be included when planning and designing new, or when retrofitting, special ventilated isolation suites of any kind (i.e. PPVL, negative pressure suite or positive pressure suite).
- The previous edition focused solely on positive pressure ventilated lobby (PPVLs) isolation suites and negative pressure single rooms with en-suites as options for source isolation. It did not address protective isolation environments for immunocompromised patients. This updated version now covers protective, source and combined source/protective isolation modes. It

presents a positive pressure suite for protective isolation, a negative pressure suite for source isolation, and a PPVL suite for combined source/protective isolation.

- This revision includes an isolation facility selection diagram that serves as a high-level visual guide for selecting and understanding the different types of isolation facility available.
- Room layout drawings are provided that show different suite configurations and lobby sizes in order to accommodate the movement of a bed through the lobby and address the impact of door swings on fixed components, which may hinder the doors fully opening:
  - Configuration 1: Inboard en-suite with 6.5 m^2 lobby
  - Configuration 2: Nested en-suite with 11 m^2 lobby
  - Configuration 3: Nested en-suite with 5 m^2 lobby.
- The bed-access lobby has increased to 6.5 m^2 (from 5 m^2) and personnel-access lobby increased to 5 m^2 (from 4 m^2) to provide adequate space for the provision of the waste bins and PPE trolley. Additionally, this allows the door to open into the lobby without clashing with the wash-hand basin.
- The chapter on “converting existing facilities” and the accompanying layout drawings from the previous editions have now been removed.
- A new schematic has been included which shows run and standby fan unit arrangements for a cluster of PPVL isolation suites in a high-rise hospital.
- In order to aid identification of the isolation suite’s dedicated function, this revision recommends that a 100 mm border should be painted on the corridor wall to outline the lobby entry door:
  - blue for a source (negative pressure) isolation suite
  - green for a protective (positive pressure) isolation suite
  - orange for a simultaneous source and protective (PPVL) isolation suite.

  The identification and functionality should be communicated to all staff members.
- A brief section on isolation wards has been included. This shows schematics for a positive pressure isolation ward and a negative pressure isolation ward.
- In this revision, it is recommended that the entire isolation suite envelope should be constructed to a 30-minute fire-resisting standard. The section on fire aspects has been amended and expanded.
- A new chapter on the planning process with accompanying checklist has been provided.
- An “important notes for users” information box has been provided to inform staff, visitors and patients on how isolation suites need to function if they are to remain effective and operational (for example, keeping doors closed, monitoring of pressure gauges, agreed procedures for emergencies and admitting large equipment into the isolation suite).
- There are separate appendices on commissioning/acceptance testing and validation and annual verification with new guidance on annual verification and commissioning. Guidance has been updated to include all three types of suite.

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Contents

1 Introduction

Healthcare facility design must uphold the principle of "first, do no harm", making patient safety the prime driver and ensuring that services are provided in a clean and safe environment that is fit for purpose. All risks need to be identified at the beginning of the design process to ensure they can be properly mitigated. Designers must fully understand their duty to consider patient safety throughout the lifespan of the buildings they work on.

Policy and context

1.1 The 'Health and Social Care Act 2008: code of practice on the prevention and control of infections and related guidance' (Department of Health and Social Care, 2022) states that "providers delivering in-patient care should ensure that it is able to make available, or secure the provision of, adequate isolation precautions and facilities, as appropriate for patients, sufficient to prevent or minimise the spread of infection".

1.2 The Code of Practice provides standards for all health and social care providers. Special ventilated isolation facilities designed according to the guidance in this HBN will meet the requirement of this Code of Practice.

Purpose of this guidance

1.3 This document is a supplement to Health Building Note 04-01 – 'Adult in-patient facilities' and covers special ventilated isolation facilities only. It should be read in conjunction with HTM 03-01 – 'Specialised ventilation for healthcare premises'.

1.4 Special ventilated isolation facilities are those in which the movement of air within the isolation facility will control the ingress and/or egress of airborne harmful pathogens and contaminants. The volume of air delivered and/or removed will dilute the contaminated air and maintain a desired pressure differential between the facility and surrounding areas. The design of the ventilation scheme and correct operation of the facility will ensure that isolation against airborne pathogens or contaminants is maintained even when the door is opened (a) between the lobby and corridor or (b) between the lobby and bedroom.

Note:

If the doors between the bedroom and lobby and lobby and corridor are opened simultaneously, or if there is a door between the bedroom and corridor and it is opened, then protection against airborne pathogens or contaminants will not be maintained.

1.5 While this Supplement focuses specifically on in-patient settings, the overall design principles and intent may be adapted and applied to isolation needs in other departments, particularly emergency departments.

1.6 Special ventilated isolation facilities consist of a patient's bedroom, lobby and en-suite.

1.7 Three possible modes of isolation from airborne pathogens or contaminants are possible to ensure that:

a. patients and staff elsewhere in the hospital do not become exposed to harmful airborne pathogens or contaminants shed by the room occupant (source isolation in a negative pressure suite)

or

b. a patient occupying the room is protected from being exposed to harmful airborne pathogens or contaminants from elsewhere in the hospital or from the outside air (protective isolation in a positive pressure suite)

or

c. both the patient in the room and other patients and staff outside of the room are protected from harmful airborne pathogens or contaminants (combined source and protective isolation in a positive pressure ventilated lobby (PPVL) suite).

Note:

The provision of isolation rooms that are switchable between positive or negative air pressure is not recommended because of the risk to people inside and outside the room in the event of the setting being incorrect. These should not be included in new or upgraded facilities.

Reasons to isolate in special ventilated isolation facilities

1.8 It is important to emphasise that clinical decisions around isolation will be made by clinical teams in consultation with IPC teams, but the following are some typical reasons for using a special ventilated isolation facility (see NHS England's (2022) 'National infection prevention and control manual for England' for more detailed guidance):

- Where a patient has a suspected or confirmed airborne infectious disease or contamination that would be spread by the airborne route (source isolation).
- Where a patient is admitted with an infection that is unknown (for example, a patient that has a specific travel history and is presenting with infectious disease symptoms) and which demands one-to-one nursing care until it is clinically safe to move that patient to a more appropriate treatment room or facility (source isolation).
- Where a patient may have become contaminated by a hazardous substance, (source isolation).
- Where a patient is being treated with gene therapy (protective isolation).
- Where a patient is known to be especially susceptible to infection or at risk of contamination from other sources, i.e. immunocompromised (protective isolation).
- Where a patient is both susceptible to infection and presents an infection risk to others (for example, immunocompromised patient with chickenpox) (both protective and source isolation).

Note:

Healthcare providers will need to balance the impacts of isolation on patients against the safety of their visitors and the workforce.

Exclusions

1.9 The design of generic single-bed en-suite rooms (i.e. without a lobby) are covered in Health Building Note 04-01 – 'Adult in-patient facilities'.

1.10 This document does not cover isolation rooms for patients with infectious diseases of high consequence (classified as Hazard Group 4 diseases). Specialist advice will need to be sought as currently no guidance exists on the design and planning of such facilities.

1.11 Isolation rooms in critical care facilities are covered in Health Building Note 04-02 – 'Critical care units'. See also HTM 03-01.

Evidence base for the positive pressure ventilated lobby (PPVL) isolation suite

1.12 The Department of Health funded an extensive programme of research in 2005 to validate the positive pressure ventilated lobby (PPVL) isolation suite concept that is covered in this document. The Building Services Research and Information Association (BSRIA) was contracted to construct a full-sized PPVL isolation suite with bed and personnel access through the lobby at their research facility, and the University of Leeds carried out complementary research into the behaviour of airborne pathogens and contaminants. A wide variety of ventilation configurations were tried and tested to determine the most effective solution. The experimental data obtained proved that the PPVL concept was robust and provided a high degree of both source and protective isolation. The result of this research has been used to inform the design specification for the PPVL concept detailed in this document. See Fletcher et al. (2007) for the resultant published research paper.

1.13 Note that two configurations of the PPVL are shown in this document:

a. With bed and personnel access through a lobby (see upper diagram, page 19)

b. With bed access directly from corridor into the patient's bedroom and personnel access through a lobby while the patient is in isolation (see lower diagram, page 19).

The Department of Health's research validated only option (a).

1.14 Poovilikunnel et al. (2020) evaluated the in-use efficacy of the PPVL for protection of patients at risk of invasive aspergillosis. The PPVL used in their research had a bed access door from the corridor to the patient's bedroom (i.e. option (b)). The airflow was assessed by visualising the direction of smoke into and out of the PPVL's lobby, patient's bedroom and en-suite facility by using a smoke test. No smoke penetration was observed through the bed-access-only door seals. Note that this study was limited to evaluating two rooms over a period of eight weeks.

Notes:

(1) The number and position of the supply and extract terminals, correct construction and appropriate air tightness are critical, and any deviation from the validated design specification for the PPVL isolation room is likely to compromise airborne isolation protection.

(2) While the PPVL suite provides for both source and protective scenarios, it is recognised that individual negative (source) and positive (protective) isolation rooms are commonly used in healthcare and are an option for providers; therefore best practice for their use is included in this Supplement.

2 Selection of isolation facilities

2.1 When designing isolation facilities, a balance needs to be struck between eliminating possible infection risks and increasing the complexity of the design. The higher the complexity, the greater the risk of in-service failure, which would consequently increase the infection risk.

2.2 There are many possible options when specifying room pressures and airflow rates for isolation suites, but complicated schemes that require specialist input for design, commissioning and maintenance have been shown to be unreliable. Furthermore, once commissioned, the rooms are likely to be in use for many years; over time, staff will change, and knowledge of the correct settings and operation may be lost. It is strongly recommended that the designs detailed in this guidance be strictly followed.

2.3 The isolation suite schemes and their detailed designs provided in this Supplement have been selected because they are simple, reliable and robust in operation. The object should be to keep the ventilation systems as simple as possible. Departing from or adding to these designs will not assure a satisfactory outcome.

2.4 Figure 1 serves as a high-level visual guide for selecting and understanding the different types of isolation facility available. It is not intended to show detailed design criteria, as Chapter 4 deals with these specifics.

Source airborne isolation (negative pressure)		Simultaneous source & protective isolation	Protective airborne isolation (positive pressure)		General comments	Health Building Note covering these types of room
	Room pressures for bedroom, lobby and en-suite					**HBN 04-01: Adult in-patient facilities** All of these rooms will provide a degree of source or protective isolation while their door to the corridor is closed. However, protection may be compromised when the door is open.
Single room		Bedroom		**Single room**	Note that the bedroom will rarely be at neutral pressure. The pressure will vary depending on the local environment. Room opens directly onto a corridor and just provides physical isolation.	
Single room: Supply and extract air volume flow rates to be calculated to maintain the bedroom at a negative pressure to the corridor. Supply air infiltration from corridor.	Bedroom		Bedroom	**Single room:** Supply and extract air volume flow rates to be calculated to maintain the bedroom at a positive pressure to the corridor. Air extracted in corridor.	Room opens directly onto a corridor.	
Single room with en-suite: Extract air from en-suite. Supply and extract air in bedroom, balanced so that bedroom is at negative pressure (typically –5 Pa) to corridor.	En-suite Bedroom		En-suite Bedroom	**Single room with en-suite:** Extract air from en-suite. Supply air in bedroom balanced so that bedroom is at positive pressure (typically +5 Pa) to corridor.	Standard single room with defined pressure regime. May also be a multi-bed bay/room where patients are cohorted.	
Single room with entry lobby: Extract in bedroom. Supply air in lobby to maintain bedroom at negative pressure.	Bedroom Lobby		Bedroom Lobby	**Single room with entry lobby:** Supply air in bedroom and/or lobby. Extract balanced to maintain bedroom at positive pressure.	Isolation suite typically used in critical care facilities.	**HBN 04-02: Critical care units**
Negative pressure isolation suite: single room with en-suite and lobby: Supply and extract air balanced to maintain bedroom and en-suite at negative pressure to lobby and corridor (see Chapter 4 for full design details).	En-suite Bedroom Lobby		En-suite Bedroom Lobby	**Positive pressure isolation suite: single room with en-suite and lobby:** Supply and extract air balanced to maintain bedroom at positive pressure to corridor and en-suite (see Chapter 4 for full design details).	Typically used where the patient is ambulant. May also be a multi-bed ward or room where patients are cohorted.	**HBN 04-01 Supplement 1: Special ventilated isolation rooms [this document]** The scheme of ventilation and provision of a lobby ensure that the degree of isolation is maintained when the door between the lobby and corridor is opened to permit access or egress. However, note that if the corridor to lobby and the lobby to bedroom door are both opened at that same time when the patient is in isolation, then the degree of isolation will not be assured.
Positive pressure ventilated lobby (PPVL) isolation suite (single room with en-suite and lobby): Neutral pressure bedroom provides source and protective isolation.	En-suite Bedroom Lobby			Supply to lobby to maintain it at positive pressure to bedroom and corridor. Bedroom is at neutral pressure. Extract in en-suite. Supply air flows from lobby via a pressure stabiliser to bedroom (see Chapter 4 for full design details).	Can be used for source or protective isolation, or where the patient requires both source and protective isolation (e.g. an ambulant patient who is immunocompromised and has chickenpox).	

Key: Neutral pressure | Negative pressure | Positive pressure

Note:
Air balancing describes the process of adjusting airflow dampers and grilles to set the correct airflows delivered through ductwork and supply grilles, etc. It is not about equality, but about how to set airflows in the right quantities and the right directions.

Figure 1 Types of isolation facility and corresponding Health Building Note coverage

3 Planning process

3.1 When planning an isolation facility, a multidisciplinary project team typically comprising a project manager, healthcare planner, architect, building services engineer, authorising engineer(s) and clinical and IPC representatives should be formed. Representatives of the client's ventilation safety group and water safety group should also be included, with representatives from other safety groups included as appropriate. The multidisciplinary project team will greatly assist in ensuring that the design specifications are fit for purpose and optimal, and this team may also assist in anticipating challenges and providing solutions for these.

3.2 In drawing up the project specification, they should consider the questions posed in the checklist in Table 1 (see also Health Building Note 00-09 – 'Infection control in the built environment').

3.3 Attention should be paid to the latest advice in the HTM 04-01 series on safe water management when considering the design and the patient population using the facilities. Clinical teams in conjunction with the Water Safety Group should complete a risk assessment of these areas ahead of the design acceptance and ensure approval from the Water Safety Group before the installation commences.

3.4 In addition to the process in paragraph 3.1, the same team supplemented by the (a) healthcare organisation's fire safety adviser, (b) local fire and rescue service (if available), (c) Authorising Engineer (Fire) (where appointed), (d) emergency planning officer and (e) Authorising Engineer/Authorised Person (Ventilation) should complete a separate fire safety qualitative design review (QDR) early at the design stage (see BS 7974) and should consider the questions in Table 2.

Table 1 The planning process

Step	Question	Design discussion and information required	Project team to provide decision and comments below
1	Why is the isolation facility required?	• State the objective(s) of the project: – Single room source isolation – Single room protective isolation – Source and protective isolation (PPVL) – Source isolation ward – Protective isolation ward – Other not covered by this document.	
2	What type of room/ suite is needed?	Select the most appropriate isolation facility(s) from Figure 1 and the number of each type required.	
3	What are the key design parameters in terms of the patient(s) who will occupy the facility?	• Decor • Entertainment opportunities • Means of maintaining societal contact/interaction e.g. window, CCTV feed, Internet • Means of communicating with staff • Additional space requirements for specific patient types e.g. patients of size or accompanied paediatric patients • Observation both from a staff line-of-sight perspective and for the patient to have visual connectivity with the staff.	
4	What are the key design features necessarily required by staff who will use the facility?	• Means of communicating with patient • Means of remotely monitoring the patient • Facility for wash/glove/gown and PPE donning and doffing • Design for cleaning and infection prevention and control.	
5	Where will the facility be provided?	• Is it a new build or within an existing building? • Will there be a need for a designated patient admission and egress route through the building?	
6	What are the design constraints within which the facility is to be constructed?	• Available space • Relationship with other facilities/healthcare specialities – access to the ward with minimal exposure to others • The provision of basic services such as power, water, drainage and plant space • Fire requirements and emergency access/egress.	
7	What are the key design parameters in terms of the room functionality?	• Specify the key physical design features and build quality required • Specify the key engineering parameters required in terms of heating, ventilation, power supplies, water and drainage services, medical gases and vacuum, and communication and IT requirements • Specify the control, monitoring and alarm strategy • Any other key design requirements e.g. overhead hoist?	
8	What information is needed for the users?	• What will the staff of the facility need to know in order to ensure that it is used correctly over its lifetime? • (Note the need for staff training to routinely check the pressure gauge and keep the doors closed.)	

(Continued)

9	What is needed in terms of resilience and diversity?	• What provision has been made with regard to resilience of the engineering services for the facility? • Will the installed engineering services be able to be routinely maintained without hazard to staff? • What arrangements have been made to ensure that the healthcare service can be provided if the facility fails to function or has to be taken out of use?	
10	Once completed, how will the facility be proven to have achieved the original objective?	See Appendix B on validation and annual verification.	
11	What steps will need to be taken when decommissioning the facility?	Are there any procedures that will need to be taken when the facility is taken out of use for refurbishment or at the end of its service life (e.g. decontamination and/or controlled disposal of materials or equipment, etc.)?	
12	How can maintenance be carried out safely?	• How can maintenance access/disruption to clinical services be minimised? • What are the validation requirements, timescales, and access arrangements?	

Note:

The number of isolation rooms to be provided will be a local decision based on demographic trends and local population needs.

Table 2 Fire safety aspects

Step	Question	Design discussion and information required	Project team to provide comment below
1	What is the overall fire strategy for the existing relevant parts of the hospital?	Does the fire strategy include: • a water suppression system • progressive horizontal evacuation • evacuation procedures and methodology • reduction of risk from medical gases including medical gas pipeline system and cylinders.	
2	What will the fire strategy for the isolation facility be?	• Water suppression system • Required fire resistance of individual rooms/suites • Fire rating/specifications for ventilation system including any fire dampers • Operation of ventilation system on alarm of fire • Reduction of risk from medical gases including medical gas pipeline system and cylinders • First-aid firefighting • Evacuation procedures and methodology including talk-through evacuation exercise for high-risk patients • Firefighting facilities and procedures.	
3	Has the risk of fire/ smoke spread within the department been addressed?	• Compartmentation/fire and smoke separation of individual room/suite • Operation of ventilation system under fire/smoke conditions.	
4	Has the issue of business continuity been fully addressed?	Has the chance of fire or smoke spread within the department been reduced to such an extent that it is unlikely to adversely affect business continuity?	

4 Design guidance

Special ventilated isolation suites – generic requirements

4.1 The following design features are generic and apply to all special ventilated isolation suites regardless of whether they are source (negative), protective (positive) or source and protective (PPVL) isolation suites.

4.2 Room layout diagrams are shown in Appendix C. For other spatial and equipment requirements, see Health Building Note 04-01 – 'Adult in-patient facilities' and Health Building Note 00-02 – 'Sanitary facilities'.

General design and construction requirements

4.3 Special ventilated isolation suites utilise the supply and extract of air to create pressure differentials and move the air in a known direction, thus providing the desired degree of protection between neighbouring spaces from airborne pathogens and contaminants. The volume of air passing through will dilute airborne contaminants arising from the occupant and those who enter the suite.

4.4 The boundary of the isolation suite envelope comprising the lobby, patient's bedroom and en-suite should be designed and physically constructed so that undesirable airflow in or out is prevented. This is described as the permeability of the room, which in simple terms is a measure of how leaky it is. If air can leak between an isolation room and an adjacent area in either direction, then this presents a route for the transmission of an airborne pathogen or contaminant. The joint between the floor/ceiling slabs and outside wall is a particular weak point and should be designed to be close-fitting and be completely sealed during construction. This will eliminate infiltration and room pressure fluctuations due to wind load.

4.5 Construction against an external façade in high-rise buildings is particularly susceptible to high external wind loading and may need additional attention to permeability so that the room pressure regime is not compromised. The room's internal pressure will be in the order of 10 pascals (Pa) while wind load on the outside of a building may be in the order of 50 Pa. It is therefore essential to prevent leakage. Similarly, the external and internal walls of the envelope should be full height, slab to slab, to prevent air leakage between adjacent spaces within the building.

4.6 Any service penetrations of the slabs or walls should be sealed at the site of their penetration. As part of the validation process, the complete envelope of the suite should be tested for leakage at first-fix prior to applying the finished surfaces and again at final validation (see Appendices A and B).

4.7 In order to ensure a tight standard of construction and reduce air permeability, the entire isolation suite envelope should be constructed to a 30-minute fire-resisting standard (similar to a hazard room). This is not solely due to the fire risk, although there may be risks in evacuating persons from the suite

that justify this approach, but also to ensure that the envelope of the suite and any service penetrations are correctly sealed. Note that it is not intended to create an air-tight box but rather to reduce to a minimum the uncontrolled air leakage into or out of the isolation suite envelope.

4.8 Once taken into use, access to the isolation suite for service, repair and maintenance will be severely limited. Items of plant or equipment that may require access should not be located above ceilings. Where possible, service access for the en-suite water fittings and valves should be via the lobby or corridor to reduce the need for maintenance staff to access the room on a regular basis. To aid this, consideration should be given to monitoring water temperatures remotely by sensors connected to the building management system (BMS).

4.9 Ceilings should be solid. Where access hatches are required, they should be of the sealable type. Push-in metal pan tile ceilings – even when subsequently sealed with mastic – should not be fitted.

4.10 Windows should be low energy, leakproof and non-opening. The windowsill in the patient's bedroom should be at a height that allows the patient to have a view from the bed. See also HBN 00-10 Part D – 'Windows and associated hardware'.

Lobby

4.11 The lobby is the room between the patient's bedroom and the access corridor. It is an essential element of airflow control particularly in managing pressures and contaminant ingress/egress when doors are opened.

4.12 The lobby should also be viewed as an essential (key) component of infection prevention and control that performs the following functions:

- a controlled area in which the transfer of supplies, equipment and persons can occur without contamination impacting the surrounding occupied healthcare areas
- a controlled area where personal protective equipment (PPE) can be donned or doffed before entry/exit of the patient's bedroom
- a controlled area providing a dedicated hand-washing facility before entry/exit of the isolation room.

4.13 Local decision-making at the planning stage will determine the approach to PPE provision and waste requirements based on patient specialties/disciplines.

4.14 The lobby should be supplied with filtered air and maintained at a positive pressure to the corridor (for further details, see specific room guidance in paragraphs 4.31–4.35). This will ensure that airborne pathogens cannot enter from the corridor.

4.15 The lobby supply air should be through a four-way blow or perforated plate diffuser set in the centre of the ceiling. This is a relatively small space so offsetting the supply towards the walls will cause undue noise and turbulence. The selection of grilles and diffusers should avoid air currents that wash against walls and floors, while still ensuring good air mixing.

4.16 The door between the corridor and lobby should open into the lobby and be fitted with a door closer (see BS 8300). The closer and air pressure in the lobby will help to ensure that door remains closed when not in use. When closed, the air leakage around the door should be no greater than that given in Appendix 4 of HTM 03-01 Part A. Cold smoke seals should be fitted, but drop seals are not required.

4.17 If bed entry to the suite is through the lobby, one-and-a-half-leaf doorsets should be fitted. Space constraints may make it necessary to hang the half-leaf from parliament hinges so that it can be opened back against the corridor or the wall of the

patient's bedroom. Once the bed has passed through the lobby, the half-leaf should be latched shut. Personnel entry and egress should be via the single door leaf. An oversized door should not be used in place of the one-and-a-half-leaf doorset.

Note:

When the bed is moved into or out of the bedroom through the lobby, the patient is NOT in isolation. The lobby therefore does not need to be large enough to accommodate the bed with both doors closed.

4.18 When adding isolation suites in an existing building, space constraints may mean that bed entry has to be from the corridor. A sliding or hinged door(s) that opens directly into the patient's bedroom may be provided. It should be fitted with seals to minimise air leakage when closed. Note that this arrangement is not the preferred option but may be the only viable design solution. The door should be secured to prevent casual use and only be opened when transferring a bed or large piece of medical equipment (for example, a C-arm) into or out of the room. It should remain locked when the room is in use as the patient will NOT be in isolation while the door is open. Staff and visitor entry and egress should always be through the lobby.

Note:

Shared lobbies are not recommended. Contaminants shed when staff remove personal protective equipment (PPE) in a shared lobby may become airborne and enter adjacent patient rooms. Additionally, opening the corridor door into a shared lobby can cause unstable air pressures and significant changes in airflow within patient rooms.

Patient's bedroom

4.19 Some patients need to stay in isolation for long periods. The number of visitors they receive and the length of time they can spend with them may be restricted. This means that patients who are already vulnerable, but not necessarily severely physically incapacitated, may be confined to the room for sometimes several weeks and can experience long periods of boredom.

4.20 Accommodation for these patients should be stimulating and as comfortable as possible. Designers should try to achieve a balance between the need for a clean environment and the comfort of patients. See the "desirable environment" section in Health Building Note 04-01 – 'Adult in-patient facilities'.

4.21 In paediatric settings, sufficient space within the bedroom to accommodate a parent/caregiver should be allowed for. It is a child's right to have access to parents/caregivers during hospitalisation, and parents/caregivers should have access to their hospitalised child. There is a responsibility to ensure that parental/caregiver visitation is implemented in a reasonable and safe manner, and this would include an IPC risk assessment.

4.22 Separation would only occur in exceptional circumstances, and in line with local policy. Depending on the ward/organisation, facilities to support parents/caregivers staying with their child may include a recliner chair or fold-out bed.

4.23 While acoustic criteria should be selected in accordance with HTM 03-01, at the project outset the project's acoustic specialist should consider and agree with the clinical stakeholders any specific noise requirements for autistic people and people with sensory processing differences and other neurodivergent or neurodegenerative conditions. However, it is important to note that accommodating neurodiversity in the design of specially ventilated isolation rooms can be challenging due to the number of air changes required in such facilities. The noise

associated with the ventilation system may adversely impact individuals with sensory sensitivities, making it difficult to strike a balance between maintaining adequate air change rates and ensuring a comfortable environment for neurodivergent patients and staff. See also the National Development Team for Inclusion (NDTi) publications:

- '"It's not rocket science"' (NDTi, 2020)
- '"It's not rocket science". Sensory friendly wards principles list' (NDTi, 2022).

These documents set out the key principles for sensory design to support autistic people in their daily lives.

4.24 If patients are to stay in an isolation room, it is important that they are able to see staff from their beds. This reduces the psychological problems of isolation. Staff should also be able to see the patient in case of emergency. Observation windows should have integral privacy blinds or electrochromic glass that can be controlled by both staff and patients. Non-intrusive monitoring of the patient may be achieved by an infrared camera linked to a monitor at the nurse station (but note that the camera does not provide an opportunity for the patient to see staff).

4.25 The sense of containment and social isolation can also be reduced by providing outside views using windows with low sills. Internet access for the patient should be provided.

En-suite

4.26 The door between the patient's bedroom and en-suite should be robustly installed and swing both ways. It should be fitted with a transfer grille in its lower half in order to promote an inflow of air to the en-suite. In all room types, there should be an extract from the en-suite.

Monitoring

4.27 For information on staff responsibilities and training, see "important notes for users" on page 20.

4.28 The pressure differential between the patient's bedroom and lobby should be monitored continuously (for example, by using a differential pressure sensor). Failure to maintain a suitable pressure should activate an alarm at a designated nurse station as well as in the estates department via a BMS. There should be a delay on the alarm (typically five minutes) when doors are opened resulting in a temporary change in pressure as staff enter or leave.

4.29 A gauge showing the pressure differential between the patient's bedroom and lobby should be mounted at eye level (1.5 m) on the corridor wall adjacent to the lobby entry door. The preferred option would be a 100 mm diameter mechanical gauge with the correct operating pressure range marked by a green sector. If a digital pressure gauge is fitted, it should display the correct operating range in green. In all cases an engraved label should be screwed to the wall below the gauge. The label should identify the room to which it refers, type of isolation (for example, source, protective or PPVL), the correct working pressure range, the ventilation system identification code (see paragraph B13 in Appendix B) and the internal number to call (for example, estates department) in case of a fault.

4.30 In order to assist staff in identifying the isolation suite's dedicated function, a 100 mm border should be painted on the corridor wall to outline the lobby entry door:

- blue for a source (negative pressure) isolation suite
- green for a protective (positive pressure) isolation suite
- orange for simultaneous source and protective (PPVL) isolation suites.

Special ventilated isolation rooms: specific requirements

Source airborne isolation (negative pressure isolation suite)

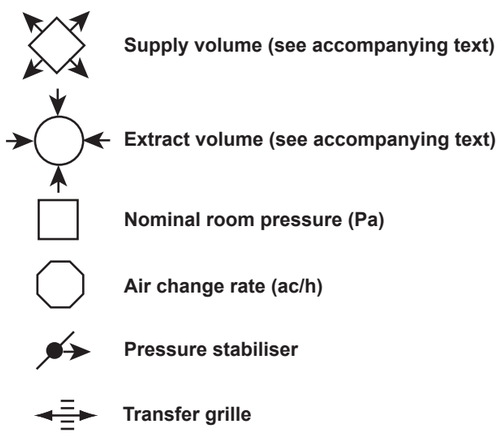
4.31 Specific isolation suite criteria:

- The higher rate of extract in comparison to the inflow of air into the patient room creates a relative negative pressure and prevents contaminated air within the room transferring to surrounding areas; the ventilation in the room dilutes airborne pathogens and contaminants.
- The lobby should be at positive pressure +5 Pa to the corridor.
- Both the lobby to corridor and the lobby to bedroom doors should open into the lobby and be fitted with door closers. The air pressure in the lobby should help to ensure that the doors remain closed after use.
- Air should be supplied into the lobby, and an above-door pressure stabiliser between the bedroom and the lobby acts as the inlet air diffuser to the bedroom.
- The bedroom should be at negative pressure: –10 Pa to the lobby.
- The bedroom should be at negative pressure: –5 Pa to the corridor.
- The patient's bedroom should have 10 air changes per hour and be compatible with patient comfort. Airflow should be fully mixed to ensure good dilution and removal of airborne pathogens and contaminants from the room space.
- The en-suite should be at negative pressure to the bedroom.
- The ventilation system has both mechanically supplied and extracted air; these should be interlocked so that, should the extract fail, the supply will cut out (otherwise the room would be under positive pressure).

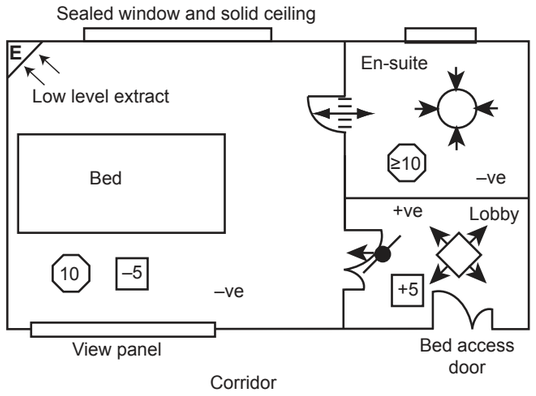
Note:

The air supply in a typically sized lobby will result in excess of 60 air changes per hour. This will rapidly dilute and remove any airborne contaminants shed when staff doff their PPE.

KEY TO SYMBOLS



Source airborne isolation (negative pressure isolation suite) with bed access through lobby



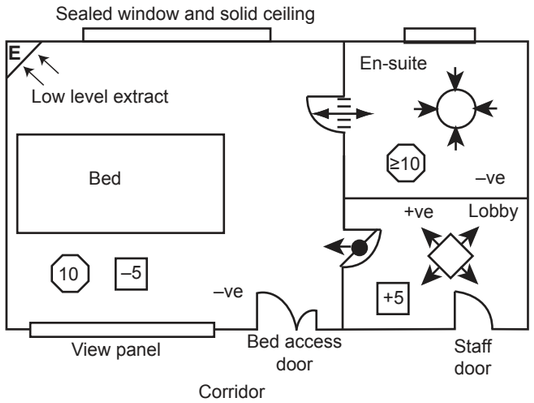
Pressures shown are relative to the corridor
Note: During commissioning, the extract should be set to give 10 ac/h to the bedroom and the supply adjusted to give the required differential pressure

Lobby (bed access)
Pressure positive (+5 Pa) to corridor
Supply air to the lobby calculated to provide 10 ac/h to the bedroom plus an allowance for the lobby to corridor air leakage

Patient's bedroom
Pressure negative –10 Pa to lobby, (–5 Pa relative to the corridor)
Low level extract in the location shown
Extract air volume to be 1/3 of that required to provide 10 ac/h in the bedroom

En-suite
Pressure negative to the bedroom
Extract air volume to be 2/3 of that required to provide 10 ac/h in the bedroom

Source airborne isolation (negative pressure isolation suite) with bed access from corridor



Pressures shown are relative to the corridor

Note: During commissioning, the extract should be set to give 10 ac/h to the bedroom and the supply adjusted to give the required differential pressure regime

Lobby (personnel access)
Pressure positive (+5 Pa) to corridor
Supply air to the lobby calculated to provide 10 ac/h to the bedroom plus an allowance for the lobby to corridor air leakage

Patient's bedroom
Pressure negative –10 Pa to lobby, (–5 Pa relative to the corridor)
Low level extract in the location shown
Extract air volume to be 1/3 of that required to provide 10 ac/h in the bedroom

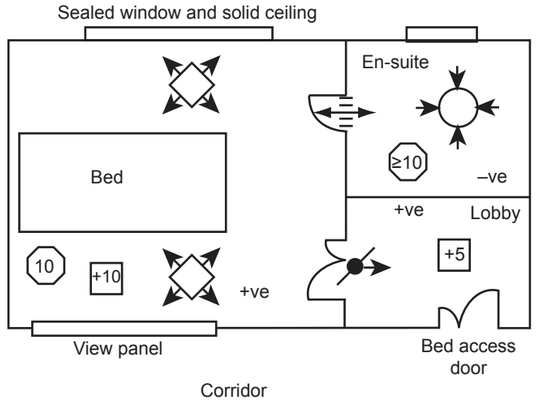
En-suite
Pressure negative to the bedroom
Extract air volume to be 2/3 of that required to provide 10 ac/h in the bedroom

Protective airborne isolation (positive pressure isolation suite)

4.32 Specific isolation suite criteria:

- The outflow of air from the bedroom (positive pressure) prevents the entry of contaminated air from surrounding areas and purges the lobby. The ventilation in the bedroom dilutes airborne pathogens introduced when staff enter.
- The lobby should be at positive pressure +5 Pa to the corridor.
- Supply EPA E12 filtered air (see table 10 in HTM 03-01 Part A) to provide 10 air changes per hour into the bedroom and transferred to the lobby via an above-door pressure stabiliser set to operate at +5 Pa.
- The bedroom air supply should provide comfort conditions in the bedroom.
- The lobby to corridor door should open into the lobby and be fitted with a door closer.
- The lobby to bedroom door should open into the bedroom and be fitted with a door closer.
- The air pressure in the bedroom and lobby should help to ensure that the doors remain closed after use.
- The bedroom should be at positive pressure +10 Pa to the corridor and +5 Pa to the lobby.
- Air flows from the bedroom to the en-suite at low level via a transfer grille in the en-suite door.
- The en-suite should be at negative pressure to the bedroom.
- Extract from the en-suite should be through a ceiling-mounted terminal.
- The ventilation system has both mechanically supplied and extracted air; these should be interlocked so that, should the supply fail, the extract will cut out (otherwise the room would be under negative pressure).

Protective isolation (positive pressure isolation suite) with bed access through lobby



Pressures shown are relative to the corridor
Note: During commissioning, the supply should be set to give 10 ac/h to the bedroom and the extract adjusted to give the required differential pressure

Lobby (bed access)
Pressure positive (+5 Pa) to corridor

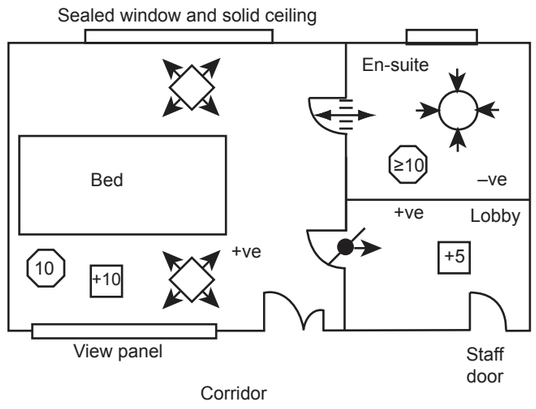
Patient's bedroom
Pressure positive +10 Pa relative to the corridor and positive +5 Pa relative to the lobby

Supply air calculated to provide 10 ac/h in the bedroom

En-suite
Pressure negative relative to the bedroom

Extract air volume to be that required to provide 10 ac/h in the bedroom minus the lobby transfer and an allowance for the isolation suite permeability

Protective isolation (postive pressure isolation suite) with bed access from corridor



Pressures shown are relative to the corridor
Note: During commissioning, the supply should be set to give 10 ac/h to the bedroom and the extract adjusted to give the required differential pressure

Lobby (personnel access)
Pressure positive (+5 Pa) to corridor

Patient's bedroom
Pressure positive +10 Pa relative to the corridor and positive +5 Pa relative to the lobby

Supply air calculated to provide 10 ac/h in the bedroom

En-suite
Pressure negative relative to the bedroom

Extract air volume to be that required to provide 10 ac/h in the bedroom minus the lobby transfer and an allowance for the isolation suite permeability

Simultaneous source and protective isolation (positive pressure ventilated lobby (PPVL) suite)

4.33 The PPVL is a single bedroom under neutral pressure with a positive pressure ventilated lobby and en-suite facilities with extract ventilation. The whole suite provides both source and protective isolation. The ventilated lobby ensures that:

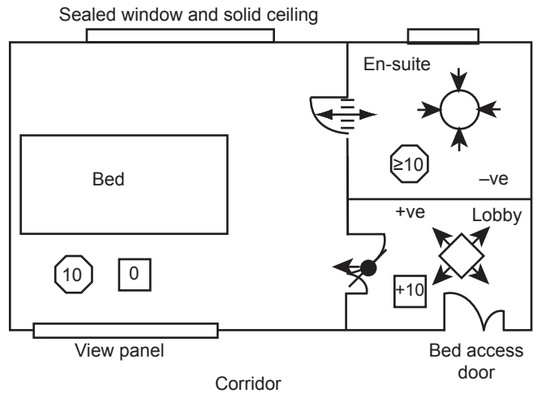
- air entering the bedroom is the clean supply from the lobby. Air from the corridor is blocked by the ventilation supply in the lobby; that is, the patient in the bedroom is protected from air entering from the corridor
- potentially contaminated air from the bedroom is prevented from escaping into the corridor by the positive pressure ventilated lobby, so the patient will not present a risk of infection to others.

4.34 This design enables the suite to be used for both source and protective isolation without the need for switchable ventilation or special training for staff. It also provides safe isolation for patients whose exact condition is unknown. As the lobby simultaneously prevents unfiltered air entering the bedroom and potentially contaminated air escaping from it, the PPVL suite can be used by both infectious patients and those at risk of infection from others.

4.35 Specific isolation suite criteria:

- The outflow of air from the lobby (positive pressure) prevents the entry of contaminated air from surrounding areas; it also purges the lobby and dilutes airborne pathogens introduced when staff enter.
- The lobby should be supplied with filtered air to provide 10 air changes per hour in the bedroom plus an allowance for the lobby to corridor door leakage. The air is transferred to the bedroom via an above-door pressure stabiliser set to +10 Pa
- The supply air should provide comfort conditions in the bedroom.
- Both the lobby to corridor and the lobby to bedroom doors should open into the lobby and be fitted with door closers. The air pressure in the lobby should help to ensure that the doors remain closed after use.
- Air flows from the lobby to the bedroom via the high-level pressure stabiliser, circulates around the bedroom and exits via the low-level transfer grille in the en-suite door.
- The lobby should be at positive pressure +10 Pa to the corridor.
- The bedroom should be at neutral pressure 0 Pa to the corridor.
- The en-suite should be at negative pressure to the bedroom.
- Extract from the en-suite should be through a ceiling-mounted terminal.
- The design concept of the PPVL suite provides a robust level of protection to the room occupant should either the supply or extract fan fail. There is therefore no need to interlock the supply and extract fans (note that this applies only to PPVLs with a bed access door through the lobby and not PPVLs with a bed access from the corridor, the latter to have interlocked supply and extract). However, if either fan fails, it should generate an alarm at both the nurse station and within the estates department so that the fault can be rectified in a timely manner.
- The supply air terminal in the lobby ceiling should be of a type that can receive an EPA E12 filter. In general, the EPA filter will not be required and should only be fitted if it is anticipated that immunocompromised patients will be occupying the PPVL suite. The supply fan should be sized to meet the increased system resistance and its output adjusted as necessary when the EPA filter is fitted.

Simultaneous source and protective isolation (positive pressure ventilated lobby (PPVL) isolation suite) with bed access through lobby



Pressures shown are relative to the corridor
Note: During commissioning, the extract should be set to give 10 ac/h to the bedroom and the supply adjusted to give the required differential pressure

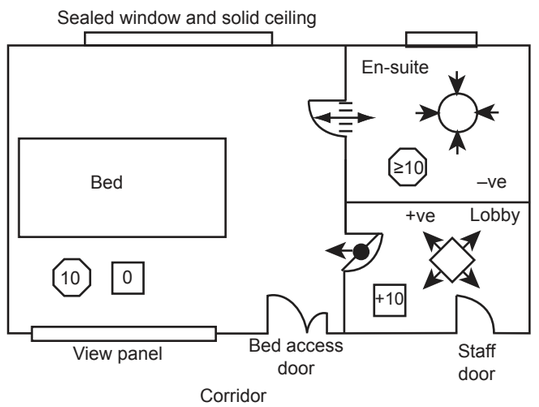
Lobby (bed access)
Pressure positive (+10 Pa) to corridor and bedroom
Supply air calculated to provide 10 ac/h in the bedroom plus an allowance for the lobby to corridor air leakage

Patient's bedroom
Pressure neutral 0 Pa relative to the corridor

En-suite
Pressure negative relative to the bedroom

Extract air volume to be that required to provide 10 ac/h in the bedroom

Simultaneous source and protective isolation (positive pressure ventilated lobby (PPVL) isolation suite) with bed access from corridor



Pressures shown are relative to the corridor

Note: During commissioning, the extract should be set to give 10 ac/h to the bedroom and the supply adjusted to give the required differential pressure regime

Lobby (bed access)
Pressure positive (+10 Pa) to corridor and bedroom
Supply air calculated to provide 10 ac/h in the bedroom plus an allowance for the lobby to corridor air leakage

Patient's bedroom
Pressure neutral 0 Pa relative to the corridor

En-suite
Pressure negative relative to the bedroom

Extract air volume to be that required to provide 10 ac/h in the bedroom

Important notes for users

It is an essential feature of special ventilated isolation suites that, when in use, only one lobby door is open at a time to ensure the high degree of airborne isolation that they can provide. If both lobby doors are open simultaneously, the degree of protection from the transfer of airborne pathogens or contaminants in either direction cannot be assured.

When a patient (either with or without a bed) is being transferred into or out of the bedroom and the doors are open to facilitate this, then the patient is not in isolation. During this period, precautions as recommended by the IPC team may need to be taken to protect the patient, staff and other building occupants from the risk of airborne infectious agents. Once the patient is in the room and access doors are closed, the patient is in isolation. Staff should then always enter via the lobby and only one door should be open at a time.

If bed entry is through the lobby, one-and-a-half-leaf entry doors should be provided. Once the bed has passed through the lobby, the half-leaf should be latched shut. Entry for personnel will be via the single door leaf.

If space constraints mean that bed entry is from the corridor, then a door(s) that opens directly into the patient's bedroom should be provided. This door should only be used for transferring a bed or large medical equipment (for example, a C-arm) into the room and should remain locked when the room is in use, as the patient will not be in isolation if the door is open. While the patient is in isolation, staff entry and exit should always be through the lobby.

Staff should be educated on the correct functioning of these rooms. Local monitoring and troubleshooting should be part of staff training. Patients and their visitors should be provided with appropriate information, including the necessity of keeping the doors closed.

In order to aid identification of the isolation suite's dedicated function, this HBN recommends that a 100 mm border be painted on the corridor wall to outline the lobby entry door:

- blue for a source (negative pressure) isolation suite
- green for a protective (positive pressure) isolation suite
- orange for a simultaneous source and protective (PPVL) isolation suite.

A room pressure gauge should be mounted on the corridor wall at eye level adjacent to the lobby entry door. The gauge should be marked with a green sector to indicate the acceptable operating pressure range. Staff should observe the gauge before entering. If the door is closed and the gauge indicates that the pressure is outside of its normal limits, there is a fault with the room ventilation. There should also be an audible and visual alarm at the nurse station. If either system indicates a fault, the estates department should be contacted. Staff who need to enter the patient's bedroom in this situation should follow local IPC policy regarding the need for, and level of, PPE to protect themselves and their patient. See also NHS England's (2022) 'National infection prevention and control manual for England' for more detailed guidance.

Alarms should be regularly checked for full functionality and settings checked as part of the regular validation.

The IPC team should agree a standard operating procedure (SOP) so that in the event of an emergency evacuation the patient will neither be at risk of infection nor present an infection risk to others.

If the isolation suite is occupied and both lobby doors or the corridor bed access door needs to be opened to admit a large piece of medical equipment (for example, a C-arm), then the IPC team should agree a SOP to protect staff and the patient.

5 Basic ventilation design parameters

5.1 Modifying or failing to provide one element of the system will jeopardise the performance of the system as a whole. The content of the entire document should be considered prior to specifying the ventilation system design in detail.

5.2 Ideally each isolation suite should have its own dedicated supply and extract system. If two or more suites share a ventilation system, there will be an inevitable increase in the complexity of the system and a corresponding reduction in reliability and serviceability. Routine maintenance or a breakdown of the ventilation system would result in the failure of all suites that it serves.

5.3 In a building with many isolation suites, a common supply and extract system may be the only feasible solution. In this case, run and standby fans would be required for the extract, and a duplicate supply unit would be necessary. Each isolation suite should be capable of being isolated from the common supply and extract so that they can be fumigated if necessary. The common supply and extract systems will need to be controlled and devices installed in the individual isolation suite's supply and extract main ducts to ensure a constant volume in each branch regardless of the number in use (see Figure 5 for an example layout).

5.4 The resilience of the electrical supply should be considered when specifying the system.

5.5 The pressure stabiliser is a critical part of the design and, particularly in the PPVL and negative pressure suite designs, it also acts as the supply air grille to the isolation room. If the pressure stabiliser is designed or commissioned incorrectly, the whole operation of the room is compromised

5.6 A pressure stabiliser of the balanced-blade type should be fitted above the door between the lobby and the patient's bedroom. Note that the orientation of the stabiliser will depend on the specific room requirement. The stabiliser should be visible so that its correct operation can be seen and it is accessible for cleaning. It should be of a style that will operate silently and be correctly sized and positioned so that it does not cause a draught that would be uncomfortable for the patient.

5.7 An extract terminal should be fitted at high level in the en-suite facility. In the case of the source protection (negative pressure) suite only, an additional low-level extract should be provided in the patient's bedroom in the position shown in the diagrams on page 15.

5.8 A transfer grille should be fitted at low level in the door between the patient's bedroom and the en-suite facility.

Note:

It is critical to the correct function of this design concept that the elements of the ventilation system – namely the pressure stabiliser(s), en-suite door transfer grille, supply and extract terminals – are located as described and indicated in the drawings in Chapter 4. Their spatial relationship will set up a cyclonic air circulation from high to low level in the patient's bedroom, ensuring all parts are efficiently ventilated, and provide the desired level of dilution protection.

5.9 A direct reading gauge showing the pressure in the bedroom with respect to the lobby should be mounted at eye level, 1.5 m above floor level, on the corridor wall adjacent to the lobby entry door. The gauge and lobby entry door should be clearly marked to identify the isolation room to which they refer, and the acceptable normal operating range should be indicated with a green sector (see also paragraphs 4.27–4.30 on monitoring). The gauge will be subject to short-term fluctuations as people enter and leave the lobby. A gauge that has a dampened action would be preferable; the intention is to demonstrate that the pressure regime is correct once all doors are closed.

5.10 Door undercuts should not be provided. Pressure differential is maintained between the bedroom and the en-suite via a transfer grille and between the bedroom and the lobby via a pressure stabiliser

Supply ventilation

5.11 The air handling unit (AHU) should comply with the requirements of HTM 03-01 Part A.

5.12 The supply AHU and distribution ductwork should be clearly marked to identify the isolation suite that they serve. Service, maintenance, cleaning and filter change of the system will be subject to a permit to work or equipment release certificate (see Appendix 3 in HTM 03-01 Part B).

5.13 An ISO ePM10 ≥50% pre-filter and a final filter to at least ISO ePM1 ≥50% standard to achieve SUP 2 (see BS EN 16798-3) indoor air quality should be fitted in the AHU.

5.14 In order to future-proof the PPVL suite, the supply terminals need to be able to accept an EPA E12 filter and provide safe changes for maintenance. Note that the fan(s) selected should be capable of meeting the increased system resistance if this option is exercised. Supply terminals in all positive pressure suites should have an EPA E12 filter.

Extract ventilation

5.15 The extract fan unit should preferably be located outside the building so that all ductwork within the building is under negative pressure (see HTM 03-01 for further guidance). Access and cleaning hatches should only be fitted where necessary. If fitted, they should be of the sealed type and marked with a biohazard symbol. If the fan has to be located inside the building, it should be as close as practicable to the outside. The extract fan motor should be mounted out of the airstream and be capable of being changed without withdrawing the impeller or opening up the ductwork. The extract fan should draw its power from the essential electrical system.

5.16 Extracted air from PPVL and negative pressure suites should be discharged at a safe location (see paragraphs 8.142–8.146 and 9.30–9.49 in Part A of HTM 03-01). Provided that the fan can discharge in a safe location 3 m above the building height, extract filters will not be required. If extract filters are fitted, they should be in a safe change housing outside the building on the suction side of the fan. Extract filters, where fitted, should be of EPA or HEPA grade dependent on the assessed risk. Even if filtered, extract air should not be recirculated (see Figures 2–4).

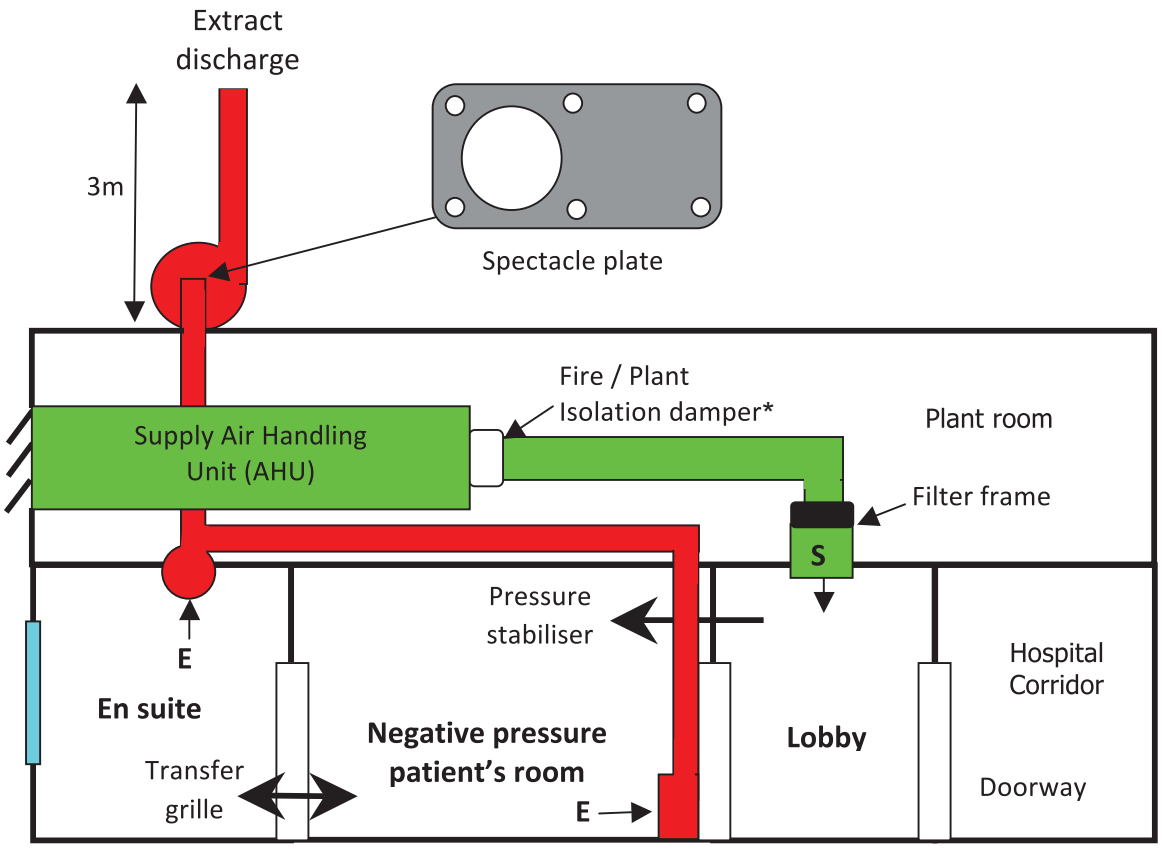
5.17 Extract ductwork, the fan and discharge stack should be clearly marked to identify the isolation suite that they serve. Service, maintenance, cleaning and filter change of the system will be subject to a permit to work or equipment release certificate (see Appendix 3 in HTM 03-01 Part B).

5.18 Extract ductwork should be kept as direct and simple as possible (see also paragraph 6.3 for fire safety requirements).

5.19 To ensure that the extract duct remains open while the system is in use, a spectacle plate should be fitted into the ductwork on the suction side of the fan. It will enable the extract system to be physically isolated when/if it becomes necessary to fumigate the isolation suite. Motorised or manually operated isolation dampers should not be fitted in the extract ductwork in lieu of a spectacle plate as they have been shown to be subject to accidental closure while the system is in use.

Note:

Figures 2–5 illustrate select key elements of ventilation design, but do not provide comprehensive details on all aspects such as fire compartmentation.



* Fire dampers should be fitted in accordance with manufacturers' instructions

Figure 2 Example of a negative pressure (source isolation) suite: ventilation schematic

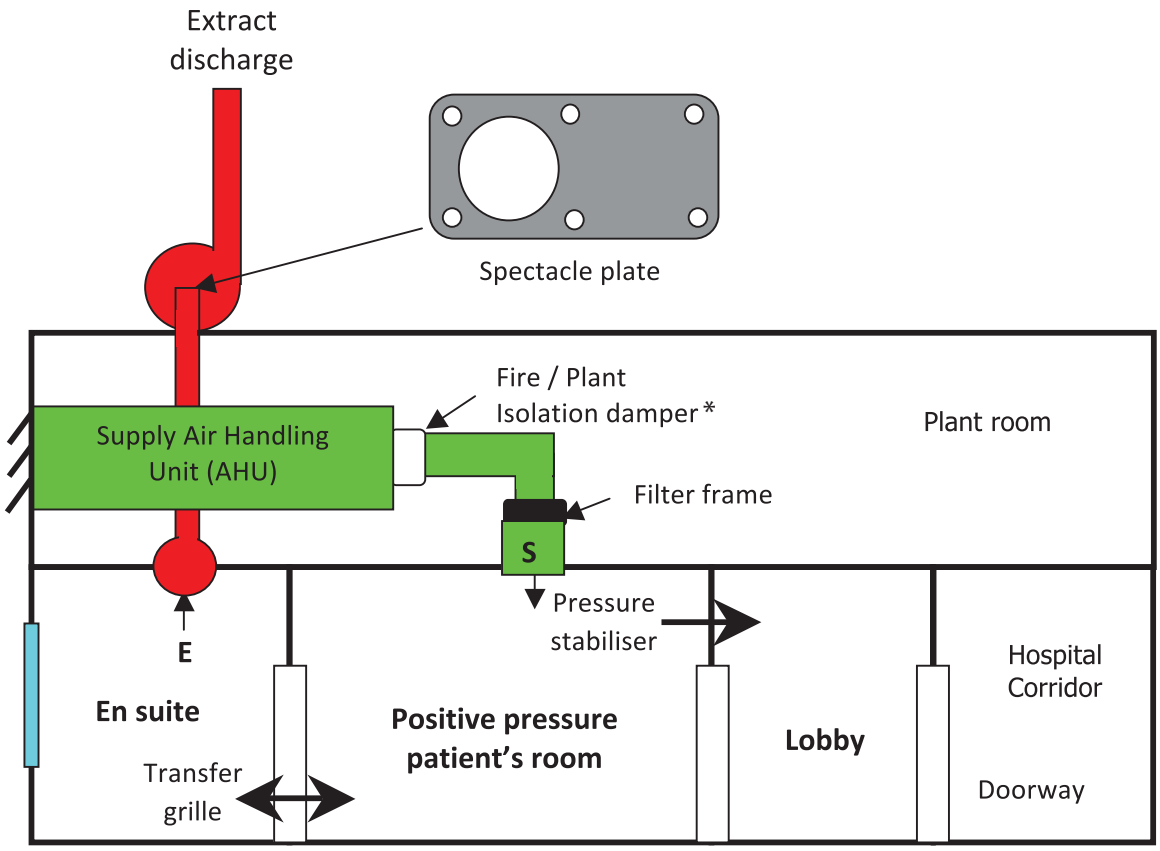


Figure 3 Example of a positive pressure (protective isolation) suite: ventilation schematic

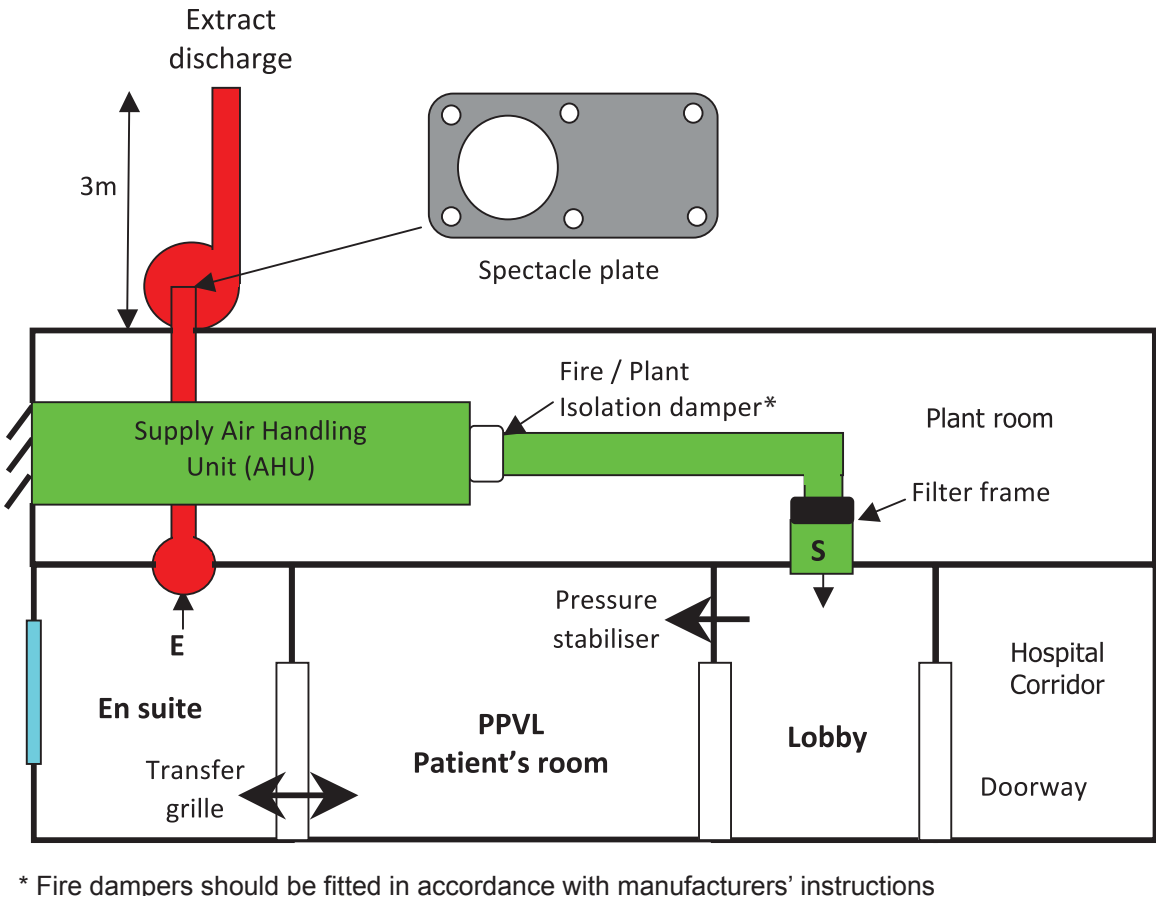


Figure 4 Example of a PPVL (source and protective isolation) suite: ventilation schematic

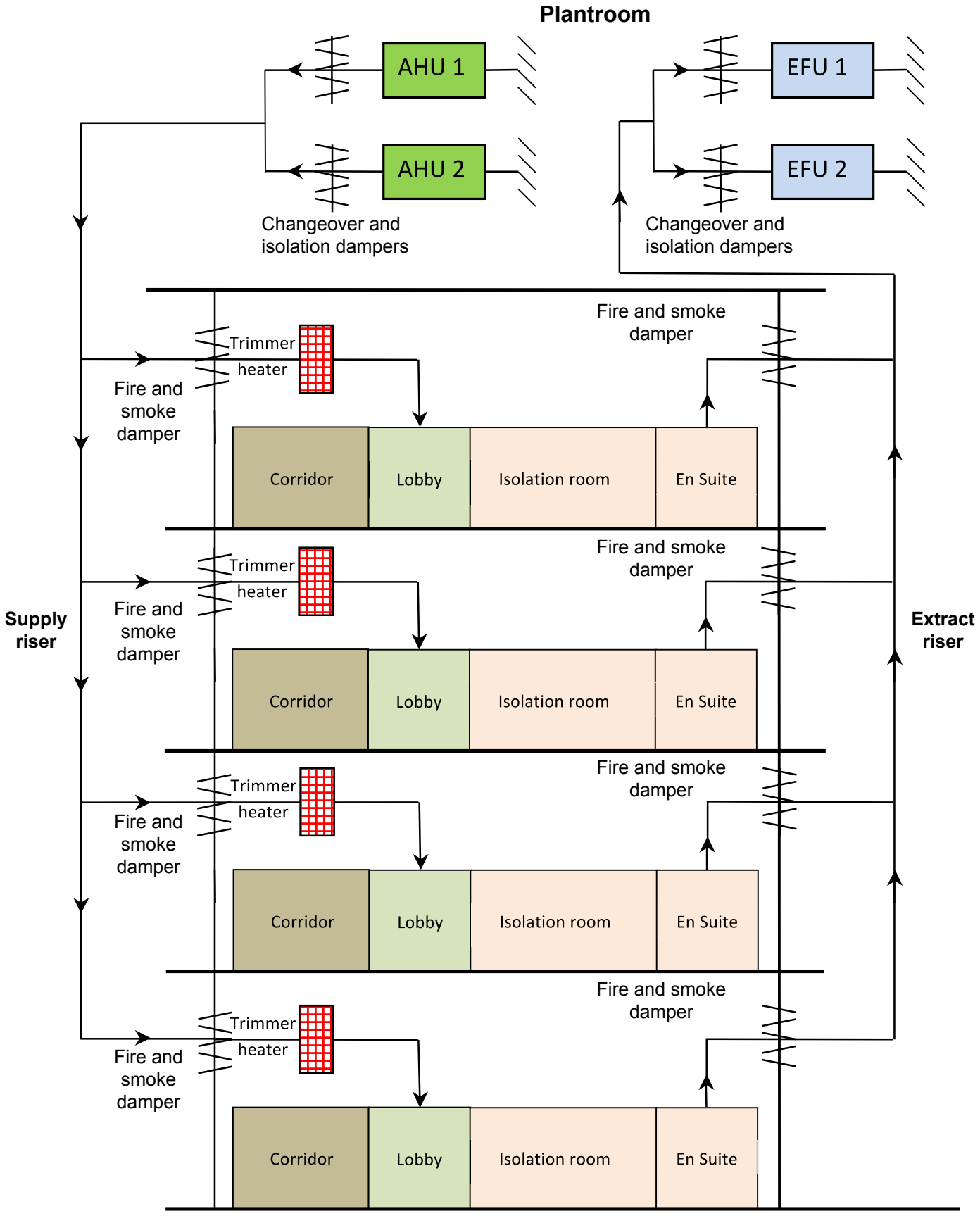


Figure 5 Suggested schematic of run and standby fan units for a cluster of PPVL isolation suites in a high-rise building. For a deep plan building the isolation suites would be distributed horizontally

Notes to accompany Figure 5

5.20 Figure 5 suggests a way of ventilating a series of vertically stacked PPVL isolation suites in a high-rise building. In a deep plan building the ventilation scheme would follow the same principle but with the isolation suites arranged horizontally. The ductwork connections for negative or positive pressure suites would be as shown in Figures 2 to 4.

5.21 The main supply AHUs and extracts (EFUs) should each be capable of meeting 80% of the full load. In normal operation, both would run at 50% output and in the event of a breakdown or during routine maintenance either one would ramp up and be capable of achieving the minimum airflow requirement (see HTM 03-01 Part B).

5.22 The supply and extract branch ducts to each isolation suite should be fitted with fire and smoke dampers as indicated. These dampers:

- enable the continued use of the isolation suite in the event of a fire
- allow the room to be completely sealed off so that thorough decontamination and deep-cleaning procedures can be regularly performed
- enable the isolation suite to be closed off for maintenance or refurbishment.

5.23 The actual provision of fire and smoke dampers needs to be agreed with the healthcare organisation's Fire Safety Adviser, Authorising Engineer (Fire) and Authorising Engineer (Ventilation). Fire and smoke dampers should be fitted according to manufacturers' instructions with the cause-and-effect scenarios carefully considered.

5.24 The system will need to be fitted with pressure sensors in the supply and extract header ducts. These will link through variable speed fans in the AHUs and EFUs to provide a constant supply and extract volume for each suite regardless of how many are in use.

5.25 See also HTM 05-02 for further guidance.

Energy recovery

5.26 Energy recovery devices add complexity to a ventilation system and increase the risk of the transfer of airborne contaminants between the supply and extract. Given the reason for providing special ventilated isolation suites and the requirement that they be robust in operation, it is not recommended that energy recovery be fitted.

Isolation wards

5.27 An isolation ward for either patients needing source (infectious) or protective (immunocompromised) or both source and protective (infectious and immunocompromised) protection will comprise several isolation bedrooms with en-suites as appropriate.

5.28 Isolation wards may include either (1) PPVL isolation suites and negative pressure isolation suites together in the same ward or (2) PPVL isolation suites and positive pressure isolation suites together in the same ward. However, negative pressure and positive pressure isolation suites should not be co-located within the same isolation ward: close proximity or shared spaces/corridors between negative pressure isolation suites and positive pressure isolation suites should be avoided due to transmission risks.

5.29 Lobbies should be provided to isolation rooms in the ward. Where this is not possible, the IPC team should be consulted on the appropriateness of any alternative approach.

5.30 Controlled entrance to the isolation ward for staff and visitors is through a lobby supplied with air which will create a positive pressure and help prevent the entry or discharge of pathogens to/from the hospital corridor. The lobby is not rated as an airlock

so there is no need to interlock the lobby doors, and both inner and outer doors can be open simultaneously for the short period while beds are passed through. Figures 6 and 7 are examples of possible layouts. Note these are suggested possible schematic layouts, not architectural designs.

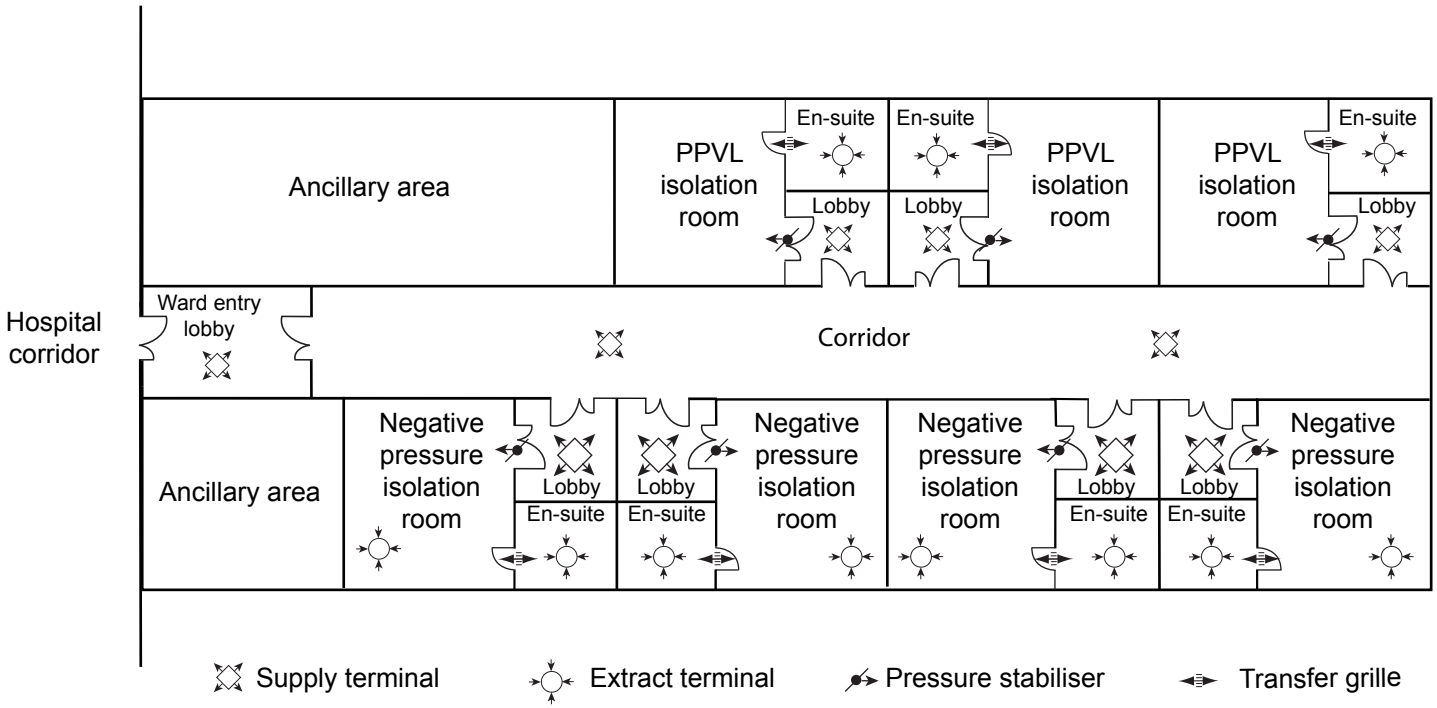


Figure 6 Schematic of possible example of negative pressure isolation ward

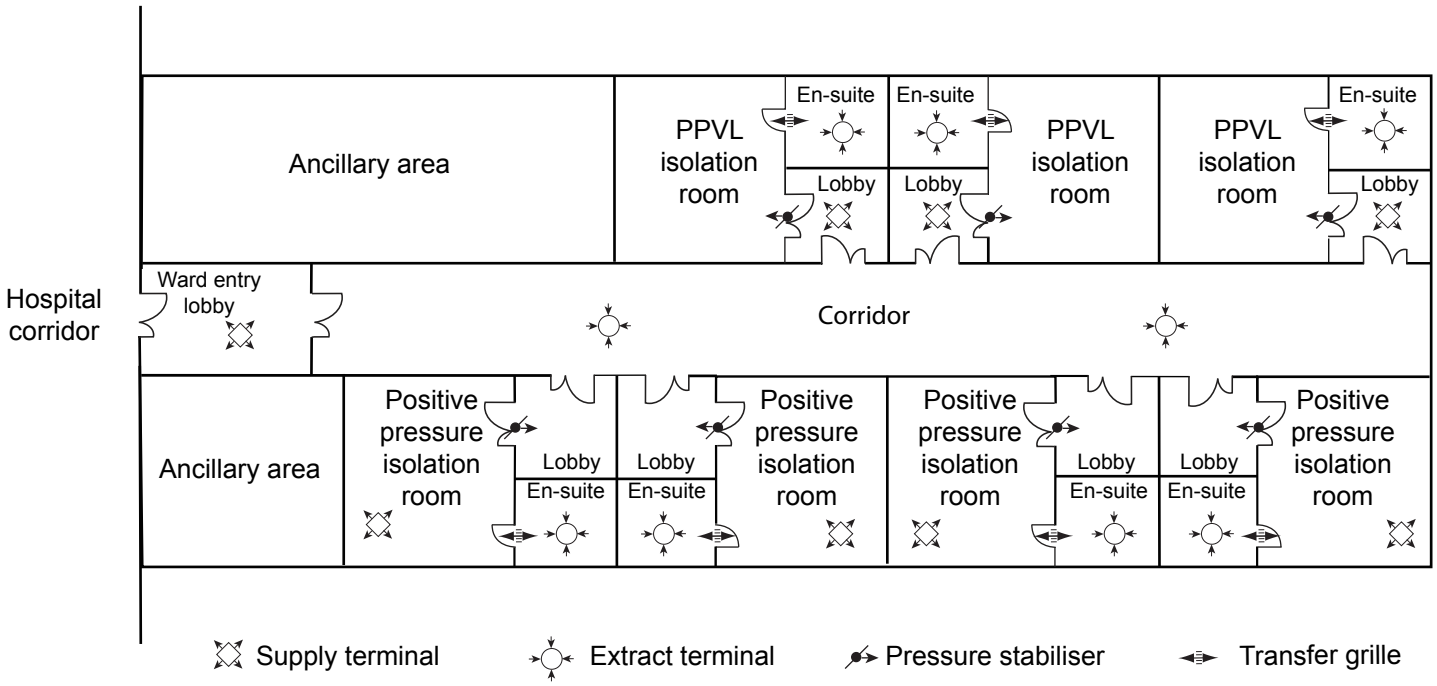


Figure 7 Schematic of possible example of positive pressure isolation ward

6 Fire safety and other engineering requirements

6.1 It is recommended that any discussions on fire safety should include the healthcare organisation's Fire Safety Adviser, the Authorising Engineer (Fire), where appointed, the building control authority and the local fire and rescue service (if available) early in the planning stage (see paragraph 3.4). However, it is essential that the risks to all users of the building from infected patients in isolation be taken into consideration. When considering the fire strategy, the IPC team and the Fire Safety Adviser should liaise closely to ensure the requirements of both parties are satisfied (see chapter 1 in HTM 03-01 Part A).

6.2 It is an essential design feature of special ventilated isolation suites that they only permit air to flow into or out of the suite via predetermined airflow paths. In order to ensure a tight standard of construction and reduce air permeability, it is recommended that the entire isolation suite envelope be constructed to a 30-minute fire-resisting standard (see also paragraph 4.7). This is not solely due to the fire risk, although there may be risks in evacuating persons from the suite that justify this approach, but also to ensure that the envelope of the suite and any service penetrations are correctly sealed. It is not intended to create an air-tight box but rather to reduce to a minimum the uncontrolled air leakage into or out of the isolation suite envelope. Note that the permeability (air leakage) of the suite will be tested as part of the commissioning and validation process (see Appendices A and B).

6.3 For all single isolation suite types, the extract ductwork should be made of PVC and fitted with suitable intumescent self-sealing collars, or similar, where it penetrates the room envelope. This set-up will not require fire dampers or their associated access hatches (see paragraph 5.14). This approach ensures that the system is simple and robust, and should the extract fan fail, the supply air will still be pushed through the suite and discharged via the extract.

6.4 For all single isolation suite types, the supply duct should be fire-rated as necessary so that the only fire damper required would be at the discharge end of the AHU (alternatively it could be in the plantroom wall or floor). The ductwork should be an extension of the isolation suite fire compartment.

6.5 In line with paragraph 6.2, cold smoke seals should be fitted to the bed access door between the patient's bedroom and corridor as this will also help to reduce air transfer between these spaces.

6.6 In the event of a fire in an adjacent compartment, the ventilation should remain running to protect the occupant from smoke in adjacent areas. In the event of a fire within the suite or when smoke from an external source is being drawn into the AHU, the ventilation should shut down (see HTM 05-02 for further guidance).

6.7 The IPC team, local managers and the healthcare organisation's Fire Safety Adviser should agree a standard operating procedure (SOP) so that, in the event of an emergency evacuation, the patient will neither be at risk of infection nor present an infection risk to others.

Other engineering requirements

6.8 With the exception of the specific ventilation requirements specified for isolation suites in this document, all other engineering services should be provided as specified in Health Building Note 04-01 – 'Adult in-patient facilities'.

6.9 As far as practicable, designers should ensure that access to domestic water services and their associated valves should be via access panels in an adjacent corridor or the lobby. Every effort should be made to avoid service and maintenance staff having to enter or pass through the patient's bedroom when carrying out programmed water temperature monitoring or routine service and maintenance tasks. See HTM 04-01 – 'Safe water in healthcare premises'.

Appendix A – Commissioning and acceptance testing of isolation rooms/suites

Definitions

Isolation suite

A1 This includes the lobby, patient's bedroom, en-suite facility and any storage or other area directly accessible from the patient's bedroom or en-suite room.

Isolation suite envelope

A2 The isolation room suite is bounded by a solid floor, solid ceiling (slab to slab), solid finished ceiling and full-height walls that separate it from any other adjoining space or the outside.

Validation – isolation suite air permeability (leakage rate)

A3 The assessment of room envelope air leakage involves establishing a pressure differential across the envelope and measuring the airflow required to achieve that differential.

Rationale:

To ensure effective isolation, it is important that air leakage to or from adjacent areas is kept to a minimum. During construction, structural gaps and service penetrations should be minimised and then permanently sealed before the suite is tested. During testing there should be no temporary seals other than those permitted (i.e. supply and extract terminals). Note that the test pressures are significantly more than would be achieved under a ventilation fault condition (that is, when it does not achieve the pressure). This should ensure that there will be a minimum of air leakage to adjacent spaces when the isolation suite is in use.

Commissioning notes

A4 All isolation suites should have their permeability checked at first-fix construction stage (see chapter 12 in HTM 03-01). The aim will be to check the construction joints, in particular the slab to outside wall, and that all service penetrations are correctly sealed as they will be inaccessible once the final fit-out is complete. The test should ensure that the envelope of the isolation suite is correctly sealed prior to the mounting of room ceilings, wall and floor finishes, medical gas covering panels, bed hoist shrouds, electrical trunking covers, IPS boxes and access hatches. The permeability test should be repeated as part of the final validation process prior to acceptance and handover.

A5 The standard for measuring air permeability for isolation suites is given in BSRIA's (2018) BTS 3/2018 'Air permeability

testing of isolation facilities' (see paragraphs B2–B6 in Appendix B on air permeability tests). The achieved figures should be issued to the ventilation safety group/Authorising Engineer for approval and validation. They should be signed off by both parties to ensure consistency and continuity prior to handover.

Source (negative pressure) isolation suite

A6 During commissioning, the extract should be set to give 10 ac/h to the patient's bedroom and the supply adjusted to give the required differential pressures. The pressure stabiliser should be adjusted to be open and stable at the required pressure differential, and should not fluctuate under steady air flow conditions.

A7 The robust direction of airflow is as important as the numerical value of the pressure differential (see paragraphs 4.31–4.35).

Protective (positive pressure) isolation suite

A8 During commissioning, the supply should be set to give 10 ac/h to the patient's bedroom and the extract adjusted to give the required differential pressures. The pressure stabiliser should be adjusted to be open and stable at the required pressure differential, and should not fluctuate under steady air flow conditions.

A9 The robust direction of airflow is as important as the numerical value of the pressure differential (see paragraphs 4.31–4.35).

Simultaneous source and protective (PPVL) isolation suite

A10 During commissioning, the lobby supply should be set to the design airflow. The en-suite extract is then set to remove the volume of air equivalent to 10 ac/h from the patient's bedroom. The lobby supply is then fine-tuned to ensure that the patient's bedroom is at 0 Pa (±1 Pa) to the corridor. A sealable test hole in the bedroom to corridor wall to enable the room pressure to be directly measured will help facilitate commissioning.

Appendix B – Validation and annual verification

Validation

B1 The isolation suite and its ventilation system should be validated as set out in HTM 03-01 Part A following initial commissioning. This will include permeability and pressure stabiliser testing as set out below.

Air permeability and pressure stabiliser

B2 Air permeability tests should be carried out by an independent testing company that is a member of the Air Tightness Testing & Measurement Association (ATTMA). Air sealers should not test their own work. The report should be as described in ATTMA Technical Standard L2 (ATTMA, 2021). See also CIBSE's (2022) 'TM23: Testing buildings for air leakage'.

B3 These tests should be carried out before initial commissioning and as necessary thereafter following works of refurbishment or when there is any doubt as to the actual performance standard of the room.

B4 As a minimum requirement, the air permeability should be no worse than that required by Approved Document L Volume 2 of the Building Regulations for the entire building.

B5 Further clarification, specifications and test procedures can be obtained from BSRIA's (2018) Test Standard BTS 3/2018 'Air permeability testing of isolation facilities'.

B6 Other tests may be necessary to check particular aspects of the specific installation. See chapter 12 on validation in HTM 03-01 Part A.

System operating standard

B7 The isolation suite will be considered fit for purpose if, with the ventilation system operating and all doors closed, the following parameters are achieved:

- the patient's bedroom has an air-change rate of at least 10 per hour when first commissioned and between 8 and 12 ac/h during its service life
- the en-suite facility is at a negative pressure with respect to the patient's bedroom
- a failure of either the supply or extract fan will be indicated at a designated nurse station and the estates department
- there is a positive pressure as specified for the designated isolation room type between the lobby and the corridor
- the pressure stabiliser between the bedroom and the lobby operates correctly during steady airflow
- all gauges accurately indicate the actual pressures
- the monitored room pressure and plant failure alarms operate correctly.

B8 In addition for a negative pressure room:

- there is a negative pressure between the patient's bedroom and the lobby
- there is a negative pressure between the patient's bedroom and the corridor.

B9 In addition for a positive pressure room:

- there is a positive pressure between the patient's bedroom and both the corridor and the lobby.

B10 In addition for a PPVL:

- there is a positive pressure of between 8 and 12 Pa between the lobby and the corridor
- the patient's bedroom is at 0 Pa (±1 Pa) to the corridor.

Annual verification

B11 Special ventilated isolation suite systems should be classed as critical systems and their performance verified annually as set out in HTM 03-01 Part B. Permeability testing may be required as part of an investigation process if the system fails to meet the operating standard set out above.

B12 The ventilation standard of performance required at annual verification will be as set out in paragraphs B7–B10. The data obtained should be entered in the system logbook and reviewed for the ventilation safety group by the Authorising Engineer (Ventilation).

Documentation

B13 A logbook retained by the estates department will be required for each isolation room/suite. It should contain the following information:

- a unique ventilation system identification code (see HTM 03-01 Part B)
- the isolation suite location, designation and type (i.e. negative, positive, PPVL)
- a schematic layout of the isolation suite and ventilation system serving it
- a schematic layout of the water services installed and designated test locations
- information on the ventilation design parameters
- a record of the actual ventilation and water system's performance at initial validation
- records of the annual verification
- records of any routine service and maintenance activities
- records of any repairs, replacement items of plant or modifications.

B14 The logbook should be reviewed by the Authorising Engineer (Ventilation) annually.

Note:

All designers need to provide robust information to allow the estates department to have this detail. See chapter 13 in HTM 03-01 Part A.

Record-keeping

B15 Information generated during the planning, design and construction phase of an isolation suite project should be retained as a BIM model or alternative archivable format. All records should be kept in digital format for five years and held by the VSG-appointed Authorising Engineer and Authorised Person.

B16 Commissioning, validation and annual verification records together with accurate and detailed monitoring records should be kept in a physical or digital logbook (see above).

B17 Records should be preserved for the life of the installation and thereafter archived for a minimum of five years.

Appendix C – Room layout diagrams

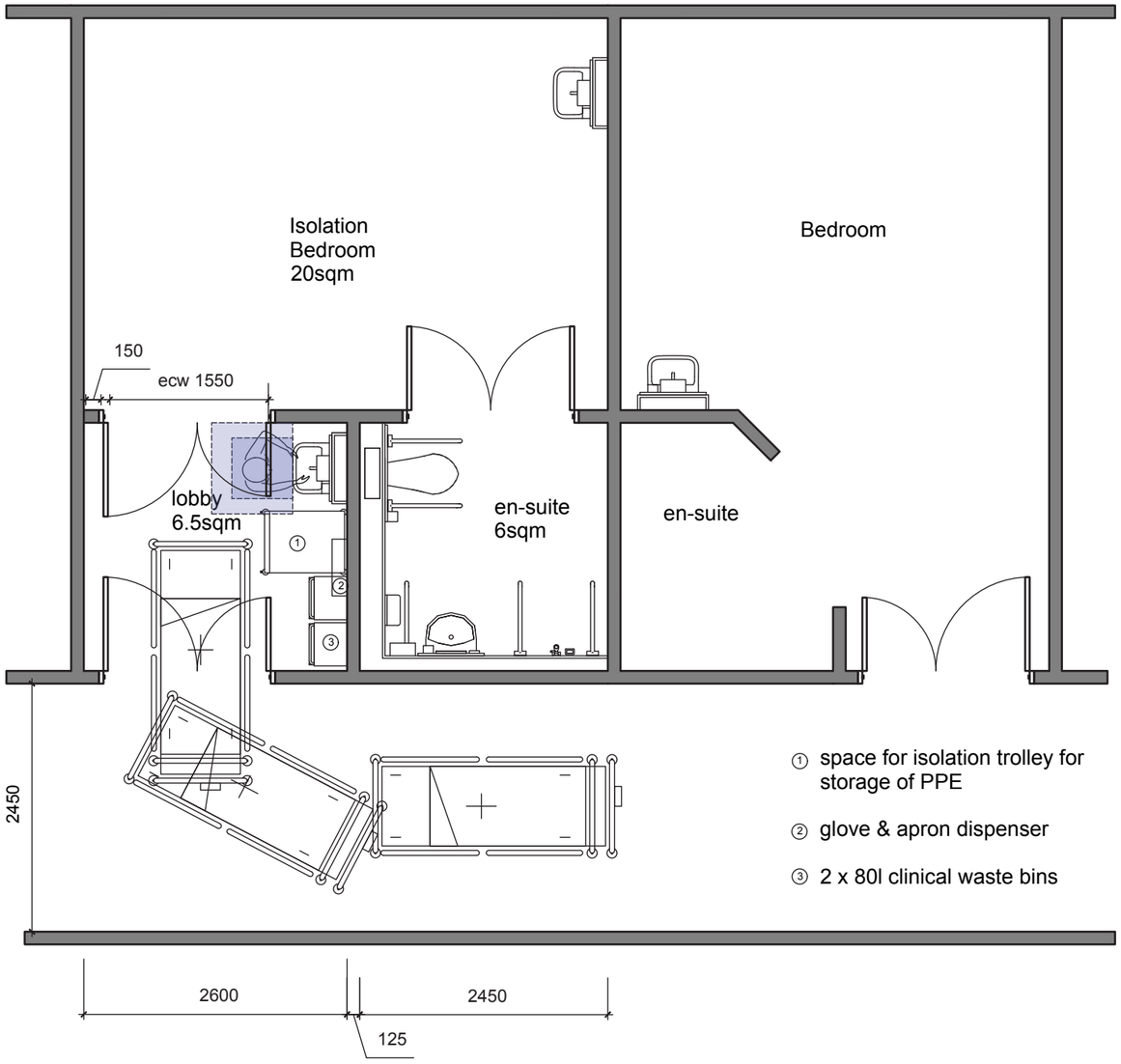
Space description

C1 The room layouts in this Appendix are intended as a guide. Refer to the section in HBN 04-01 'Adult in-patient facilities' on specific functional and design requirements for bed and sanitary facility needs. Chapter 4 of this document covers both general and specific design requirements for all types of special ventilated isolation suites.

C2 While incorporating isolation suites in a typical ward configuration at early design stages, it is worth considering:

- The proportions and configuration of the isolation suite i.e. bedrooms, lobby and en-suite may be different from the repeatable room module of a typical bedroom unit used elsewhere in the ward. Coordination with the structural grid and integration with other repeatable rooms should be considered.
- The location of the suite(s) as part of a generic adult ward should be agreed with clinical stakeholders (for example, adjacent to the department entrance for swift access to the room in order to minimise the distance that infectious or high-risk patients need to travel through the ward area and thereby protect the patient, staff and other building occupants from the risk of airborne infectious agents, or proximity to staff areas to improve observation).
- The location of the suite should be coordinated with design engineers to identify routes for dedicated ductwork serving the room.

Configuration 1: Inboard en-suite with 6.5 m² lobby

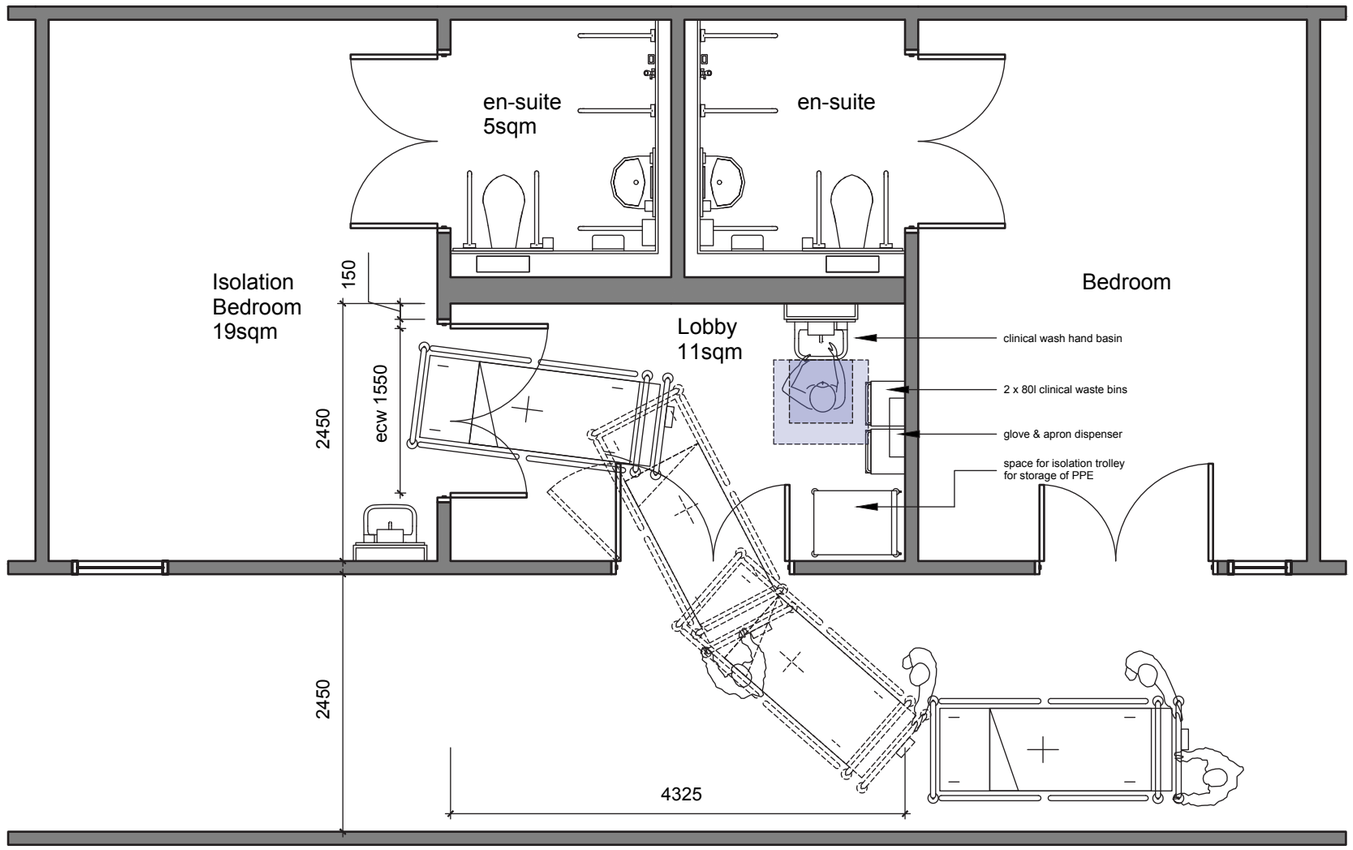


Negative pressure and PPVL lobby example; for a positive pressure bedroom the door will open from the lobby into the bedroom

Considerations: configuration 1

- Bed movement is within the lobby alongside personnel entry to the bedroom.
- This results in a wider bedroom to accommodate the lobby and a larger en-suite; the depth of the isolation suite aligns with typical inboard bedroom dimensions.
- The larger bedroom and en-suite is a consequence of lobby setting out.
- Both sets of doors into the bedroom require large glazed vision panels to enable patient observation.
- Digital methods such as camera and smart beds may support observation.
- There is potential for service access to the en-suite wash-hand basin and shower from the corridor (see paragraph 4.8).
- The provision of glove/apron dispensers should be agreed with clinical and IPC stakeholders.
- The provision of a bedroom wash-hand basin should be agreed with clinical, IPC and water safety group (WSG) stakeholders.
- Note that the isolation trolley may need to be moved out of the lobby during any bed movement.

Configuration 2: Nested en-suite with 11 m² lobby

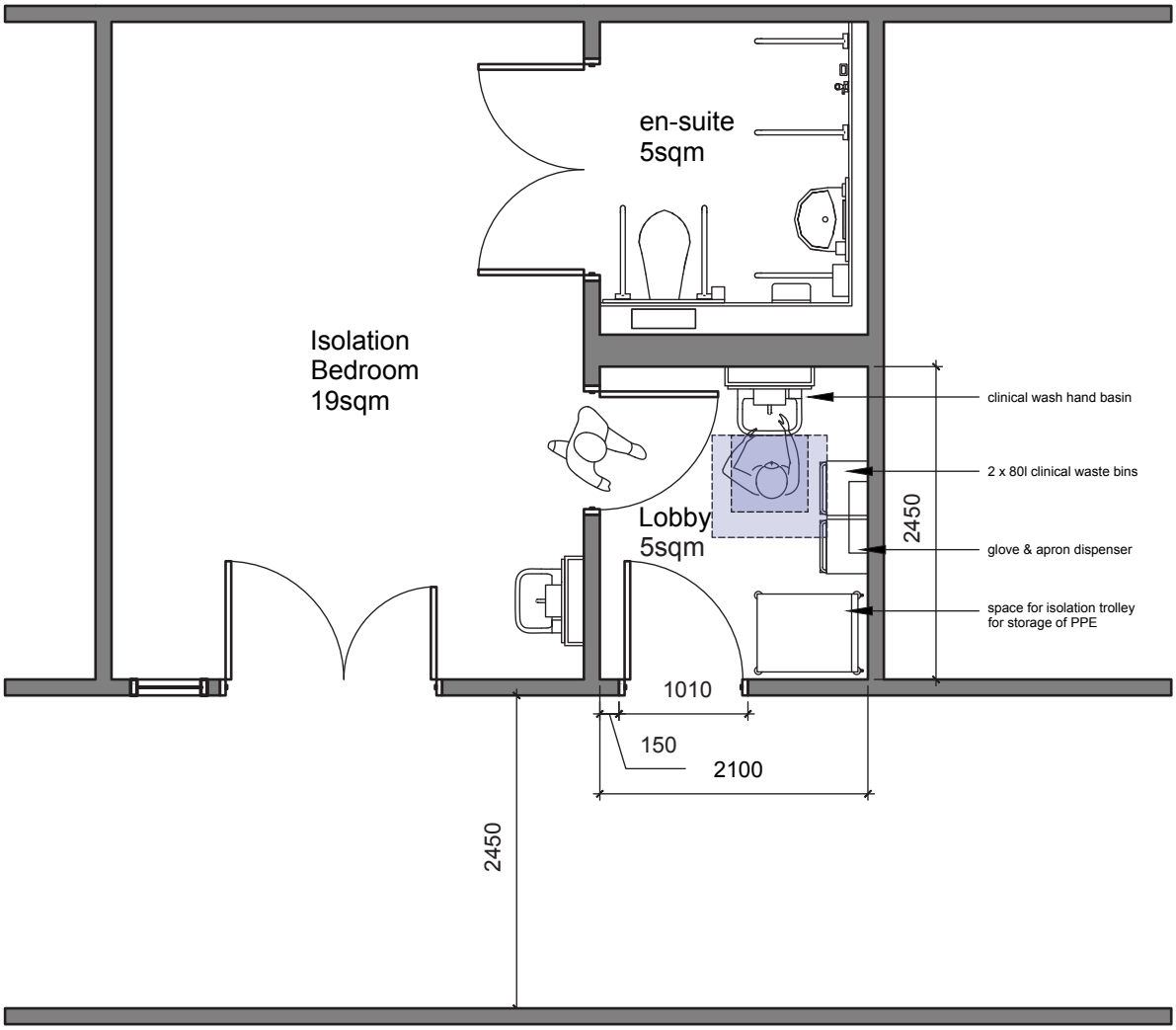


Negative pressure and PPVL isolation suite example; for a positive pressure suite, the doors will open from the lobby into the bedroom

Considerations: configuration 2

- Bed movement is within the lobby alongside personnel entry to the bedroom.
- This configuration utilises a standard “nested” en-suite arrangement to create a lobby spanning the width of two en-suites.
- There is potential for service access to the bedroom wash-hand basin and en-suite wash-hand basin from the lobby or corridor (see paragraph 4.8).
- This configuration enables a glazed screen for patient observation from the corridor.
- The provision of glove/apron dispensers should be agreed with clinical and IPC stakeholders.
- The provision of a bedroom wash-hand basin should be agreed with clinical, IPC and water safety group (WSG) stakeholders.
- Note: this layout is **not** showing a shared lobby; the bedroom to the right is not part of the isolation suite.

Configuration 3: Nested en-suite with 5 m² lobby



Negative pressure and PPVL isolation suite example; for a positive pressure suite, the doors will open from the lobby into the bedroom

Considerations: configuration 3

- The lobby is for personnel use only.
- Bed movement is directly into the bedroom.
- This configuration utilises a standard “nested” en-suite arrangement to create lobby, bedroom and en-suite proportions as a general bedroom suite.
- There is potential for service access to the en-suite and bedroom wash-hand basins from the lobby (see paragraph 4.8).
- This configuration enables a glazed screen for patient observation from the corridor.
- The provision of glove/apron dispensers should be agreed with clinical and IPC stakeholders.
- The provision of a bedroom wash-hand basin should be agreed with clinical, IPC and water safety group (WSG) stakeholders.

References

The publication dates provided in the references list below correspond to when this edition of HBN 04-01 Supplement 1 was drafted. The dates give context on the currency of referenced sources at the time of writing.

Standards and other specification documents are continually being updated, and readers should ensure they consult the latest editions of such documents, including any amendments issued after publication, to ensure they remain up to date with and can react to changing requirements.

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NHS England
Wellington House
133-155 Waterloo Road
London
SE1 8UG

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