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Shared Services Partnership
Specialist Estates Services

WHBN 04-01
Supplement 2

Welsh Health Building Note

Negative Pressure Suites

Technical Guidance in support of Welsh Health Circular WHC (2018) 033 Airborne Isolation Room Requirements

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Welsh Health Building Note 04-01 Supplement 2 : Negative Pressure Suites

Overview

This document sets out practical guidance on how to provide safe, effective isolation facilities for infectious patients (source isolation) that are simple to use and meet the requirements of Welsh Government as outlined in WHC (2018) 033.

The guidance describes:

- How a negative pressure suite comprising a negative pressure bedroom, en-suite sanitary facilities and positive pressure ventilated lobby can provide isolation protection for patients with an infection that can be spread by the airborne route.

It can be used for both new-build schemes and the upgrading of existing accommodation.

This document should be read in conjunction with:

- WHBN 00-09 – 'Infection control in the built environment'. The document provides information about how good design can prevent cross-infection in healthcare premises generally.
- WHBN 04-01 – 'Adult in-patient accommodation', which covers the planning and design of in-patient facilities for adults and includes space standards for bed areas (including isolation rooms and lobbies).
- WHBN 00-03 – 'Clinical and clinical support spaces', which provides detailed design information and layouts for single-bed rooms.
- HTM 03-01 – 'Specialist ventilation for healthcare premises, Part A: Design, installation, validation and verification'.

Policy on the location and number of isolation rooms

For policy advice on the location and number of isolation rooms that should be provided, NHS Trusts / Health Boards are advised to contact the Welsh Government's Department for Health and Social Services and refer to WHC (2018) 033.

Contents

Chapter 1

Introduction

1.1 The infection prevention and control team should be closely involved with all aspects of planning for, and determining the provision of, isolation facilities. When undertaking a project, a multi-disciplinary approach should involve the:

- infection control team and clinical team;
- architect and designer;
- building contractor and mechanical/electrical maintenance service providers;
- in-house estates team.

Exclusions

1.2 This guidance does not describe the specialist facilities required in the following:

- high security infectious disease units;
- isolation wards for cohorting groups of infectious patients;
- protective isolation for severely immune-compromised patients;
- critical care areas; and
- special care baby units.

These specialist facilities will require bespoke solutions.

1.3 This guidance focuses on single occupancy isolation rooms only.

Chapter 2

Negative Pressure Suite

2.1 A Negative Pressure Suite (NPS) is a single-bed room with a ventilated lobby and en-suite sanitary facilities with extract ventilation (see **Appendix 1** for an example layout).

2.2 The ventilated lobby ensures that air entering the bedroom is the clean, filtered, ventilation supply from the lobby; potentially contaminated air from the bedroom is prevented from escaping into the corridor by the ventilated lobby.

2.3 The use of personal protective equipment (PPE) will be determined by local infection prevention and control policy. Facilities for putting on and removing PPE, and washing hands, are provided in the lobby. The risk of contaminants being dislodged from used PPE by the ventilation system and blown out into the corridor is considered negligible. However, a hand-wash basin and disposal bin are also provided in the bedroom close to the exit door so that PPE can be removed in the bedroom should local policy require.

2.4 The benefits of the negative pressure suite are that it is simple in concept, requires no specialist knowledge by the nursing staff to operate it, and can also be used for general nursing. In addition, if the ventilation system fails, the layout of the suite still ensures a degree of protection.

Room criteria

2.5 The following criteria are considered essential:

- one or more pressure stabilisers must be installed above the door between the lobby and the bedroom.
- A suitable extract system to the en-suite facility must be provided.
- A transfer grille in the lower section of the en-suite door must be installed.
- To support the room being well-sealed, the detail of the construction joints between elements of the building and service penetrations will be critical to achieving the air leakage standard demanded. The joints must be carefully sealed as construction progresses and service penetrations minimised, as they will be inaccessible once the inner finish is applied (see **Appendix 2** acceptance testing of NPS).
- The door between the corridor and the lobby must open into the lobby and be fitted with a door closer. The door between the lobby and bedroom must open back into the lobby and be fitted with a door closer. This is to ensure that the closure of both doors is aided by the lobby pressure, thus maintaining the airflow direction and pressure regime of the suite.

2 Negative Pressure Suite

In the lobby:

- a clinical hand-wash basin with non-touch, fixed temperature mixer tap;
- wall-mounted soap dispensers, disinfectant hand rub dispensers, and disposable towel holders;
- wall-mounted plastic apron and glove dispensers and storage for other clean PPE items;
- a clinical waste bin for disposal of used PPE;
- a bin for disposing of paper towels and other non-clinical items;
- storage for room cleaning equipment;
- a suitable air supply.

In the bedroom:

- a clinical hand-wash basin, with non-touch, fixed temperature mixer tap, adjacent to the exit door;
- wall-mounted soap dispensers, disinfectant hand rub dispensers, and disposable towel holders;
- a clinical waste bin for disposal of used PPE;
- Bed entry to the suite is through the lobby, suitable door sets will need to be fitted. Once the bed has passed through the lobby, the second-leaf must be latched shut. Entry for personnel will be via the single door leaf. An oversized door must not be used in place of the one-and-a-half-leaf door set.

2.6 Heating and cooling of the isolation suite will be provided via the ventilation system, controlled between 18 to 24°C.

2.7 The provision of a two-way intercommunication system between the bedroom and the nurses' base should be provided.

2.8 For space requirements see WHBN 04-01 — 'Adult in-patient accommodation'.

2 Negative Pressure Suite

Basic design parameters

2.9 The bedroom must have 10 air changes per hour delivered through the mechanical ventilation system and be at a pressure of between -5pa and -10pa with respect to the corridor. The entry lobby shall have a positive pressure with respect to the corridor of between 5pa and 10pa. Similarly, to the bedroom, the en-suite facility must have at least 10 air changes per hour and be at a negative pressure with respect to the bedroom. **Table 1** below gives nominal design values calculated for rooms of the size stated.

Name	Parameter	Nominal design value
Lobby	Room volume: Bed access lobby (5 m2 x 2.7 m)	13.5 m^3
	Pressure differential to corridor	5 to 10 pa
	Supply air flow (see Note 3)	Sufficient to maintain bedroom air change rate
	Air change rate	Sufficient to maintain bedroom air change rate
Bedroom	Room volume (19 m2 x 3 m)	57 m^3
	Pressure differential to corridor	-5pa to -10pa
	Room air flow	158 l/s
	Air change rate	10 per hour
En-suite	Room volume (6 m2 x 2.7 m)	16.2 m^3
	Pressure differential to isolation room	Negative
	Extract air flow	As required to maintain bedroom negative pressure
	Air change rate	At least 10 per hour

Notes

1. In this example, the design parameters are based on WHBN 04-01 — 'Adult in-patient accommodation. The en-suite is sized to comply with BS 8300 accessibility requirements.
2. The air flow rates quoted do not include any allowance for construction leakage. Air tightness specifications are given in Approved Document L of the Building Regulations (2010). See also the Air Tightness Testing & Measurement Association's (ATTMA) 'Technical Standard L2: Measuring air permeability of building envelopes (non-dwellings)'
3. These are typical values based on standard room sizes. The actual volume of air required will be the sum of the air required to provide 10 air changes per hour in the bedroom + the air leakage through the door between the lobby and corridor at the design differential pressure. (See Appendix 4 in HTM 03-01 Part A for leakage rate for single and double doors.)

Table1: Negative Pressure Suite — ventilation parameters

2 Negative Pressure Suite

2.10 Modifying or failing to provide one element of the system will jeopardise the performance of the system as a whole.

2.11 An extract terminal must be fitted at high level in the en-suite facility.

2.12 A transfer grille must be fitted at low level in the door between the bedroom and the en-suite facility.

2.13 A pressure stabiliser of the balanced blade type, set to operate at 10pa, must be fitted above the door between the lobby and the bedroom. The stabiliser must be visible so that its correct operation can be seen. It must be of a type that will operate silently, and be correctly sized and positioned so that it does not cause a draught that would be uncomfortable for patients.

Note:
It is critical to the correct function of this design concept that the stabiliser is fitted as described and the transfer grille in the en-suite door also be fitted as described. This will set up a cyclonic circulation in the bedroom and provide the desired dilution protection.

2.14 The supply air handling unit (AHU) can be a separate unit or a unit supplying the area adjacent to the suite but must comply in all respects with the minimum standards set out in HTM 03-01 'Specialised ventilation for healthcare premises'. Heating and cooling must be provided, but no humidification. The supply AHU and the extract fan must draw its power from the essential electrical system.

2.15 Typical configurations for dedicated AHU and General AHU situations are shown below in **Figures 1 & 2** respectively.

2 Negative Pressure Suite

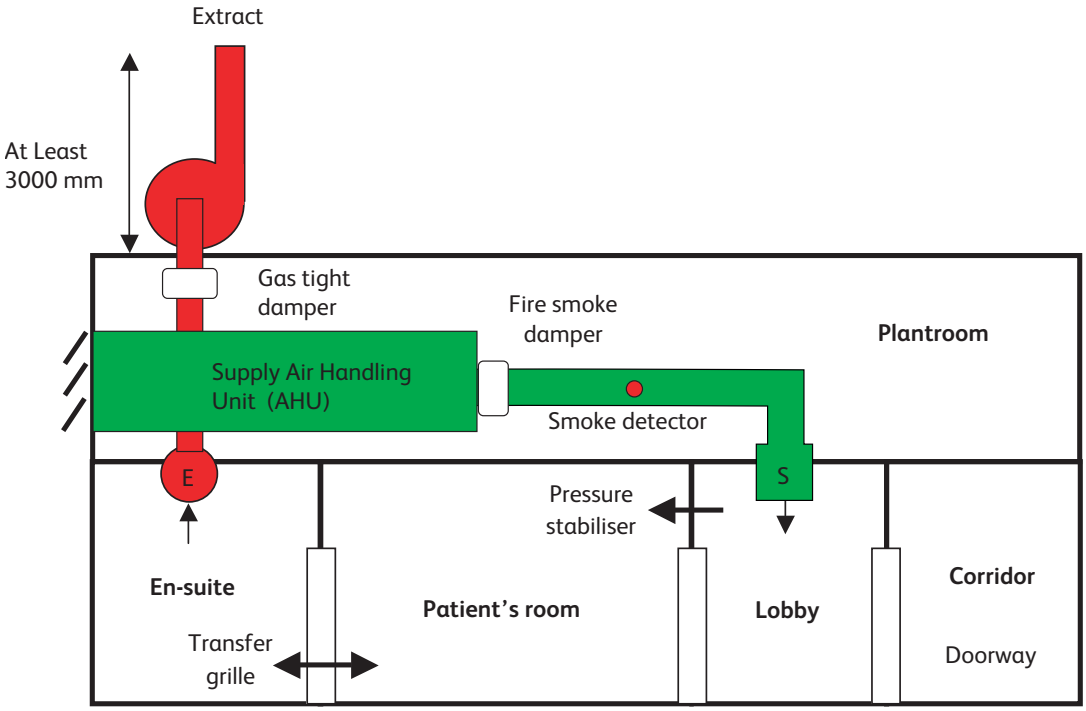

Figure 1 Supply and Extract Ventilation – Negative Pressure Suite (Dedicated AHU)

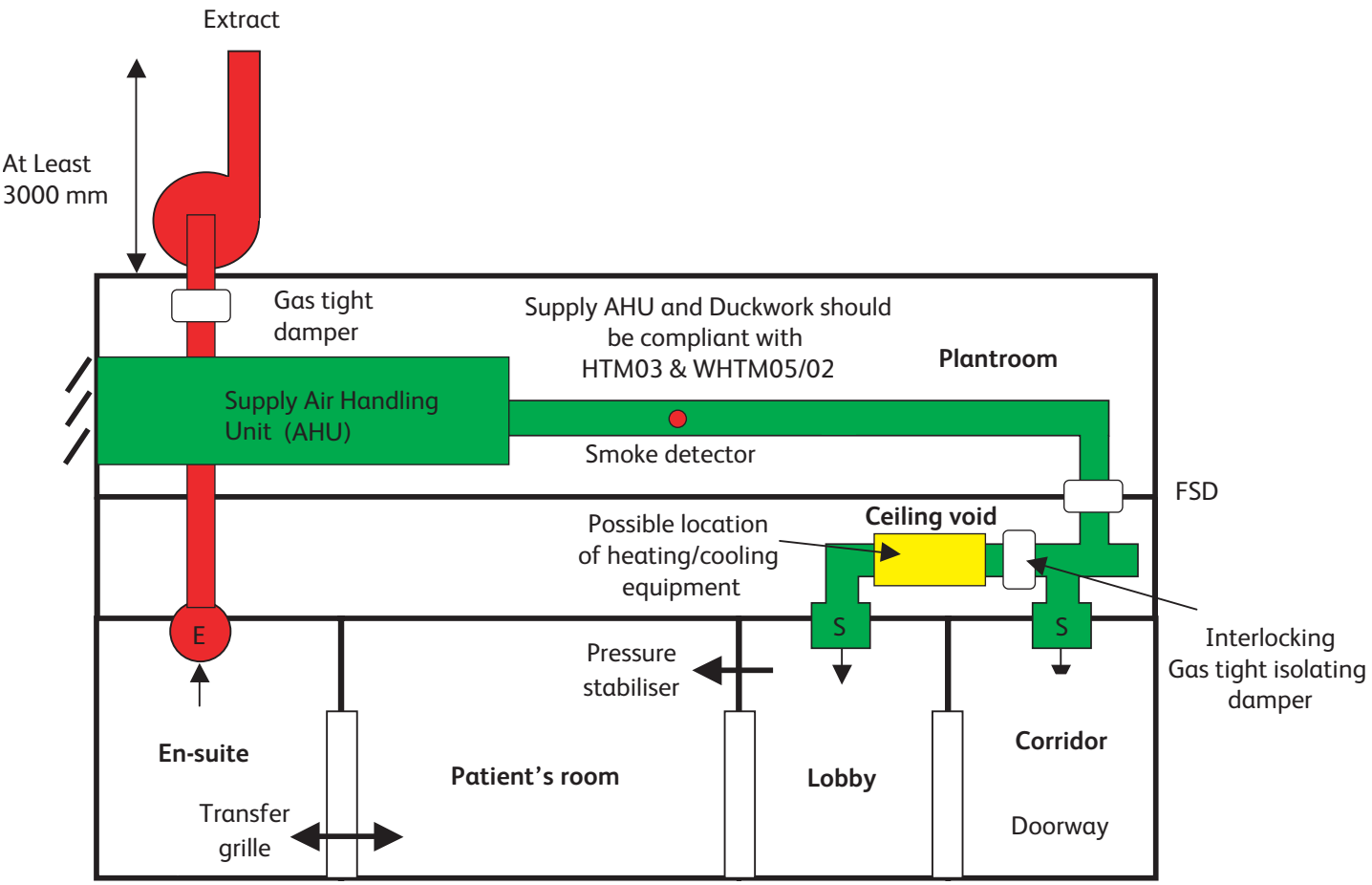

Figure 2 Supply and Extract Ventilation – Negative Pressure Suite (General AHU)

2.16 A direct reading gauge showing the pressure in the bedroom with respect to the corridor must be mounted at eye level on the corridor wall adjacent to the lobby entry door. The gauge and lobby entry door must be clearly marked to identify the isolation room to which they refer.

2.17 Door undercuts are not permitted.

Supply ventilation - negative pressure suite

2.18 The AHU and distribution ductwork must 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.

2.19 The supply duct must be fitted with a gas-tight damper so that the system can be sealed to allow the isolation suite to be disinfected.

2.20 G4 pre-filter and a final filter to F7 standard must be fitted in the AHU.

Monitoring and record keeping

2.21 A record of pressure differentials, observed and recorded at the start and end of each nursing shift, must be made. Ward staff must be made aware of what to do if the readings are out of specification.

Extract ventilation – negative pressure suite

2.22 The extract fan unit should preferably be located outside the building so that all ductwork within the building is under negative pressure. Access and cleaning hatches must only be fitted where absolutely necessary. If fitted, they must be of the sealed type and marked with a biohazard symbol. If the fan has to be located inside the building, it must be as close as practicable to the outside. The extract fan motor should be mounted out of the air stream and must be capable of being changed without withdrawing the impeller or opening up the ductwork or fan casing. The extract fan must draw its power from the essential electrical system.

2.23 Extract filters will not be required provided that the fan can discharge in a safe location at least 3000 mm above the building height. In exceptional circumstances safe change filters could be installed, in which case they should be enclosed in a fire rated enclosure if located within the building. Extract filters, where fitted, must be of HEPA H14 grade. Even if filtered, extract air must not be recirculated.

2.24 Extract ductwork, the fan and discharge stack must 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.

Negative Pressure Suite

2.25 The extract duct must be fitted with a gas-tight damper so that the system can be sealed to allow the isolation suite to be disinfected. The damper must be fitted at the inlet of the extract fan. This will also permit isolation of the extract fan for service and maintenance.

2.26 Each negative pressure suite must have its own extract system.

2.27 The object must be to keep the ventilation systems as simple as possible. Standby fans or motors are not required. A differential pressure switch must be fitted to each system that will alarm on fan failure at a designated nurse station and the estates department. On extract fan failure, the supply to the suite must also be automatically isolated or switched off.

2.28 Extract ductwork must be kept as direct and simple as possible. In order to facilitate duct cleaning, volume control devices and other obstructions in the distribution ducts must be avoided. Flow rates must, where possible, be set by terminal and duct size design. In the unlikely event that volume control devices are required, iris dampers are the preferred type.

Documentation

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

- a schematic layout of the isolation suite and ventilation system serving it;
- information on the ventilation design parameters;
- a record of the actual ventilation performance at initial validation;
- records of annual validations;
- records of any routine service and maintenance activities;
- records of any repairs or modifications;
- records of the bedroom pressure, taken by ward staff;
- a method statement for disinfecting the system.
- records of permit to work.

2 Negative Pressure Suite

Other considerations

2.30 As far as practicable, access to domestic hot and cold water services and their associated thermostatic mixing valves must be via access panels in the lobby or corridor. Every effort must be made to avoid service and maintenance staff having to enter or pass through the bedroom when carrying out routine service and maintenance tasks.

Service and maintenance

2.31 Gas-tight dampers must be used to seal the system, should the suite and/or its ventilation system require disinfection. A method statement must be prepared detailing the procedure. For further guidance on disinfection refer to 'Biological agents: Managing the risks in the laboratory and healthcare premises' (Health and Safety Executive: Advisory Committee on Dangerous Pathogens). All works of service and maintenance must be subject to a permit to work.

2.32 Please see **Appendix 2** for provisions concerning Acceptance testing of Negative Pressure Suites.

Chapter 3

Fire Safety

3.1 It is recommended that fire safety considerations should be discussed with the healthcare organisation's fire safety adviser, the building control authority and the local fire-and-rescue service.

3.2 The fire precautionary measures and response procedures for isolation facilities should be coordinated with the site's overall fire strategy. In general, the location of isolation facilities within a ward are unlikely to offer alternative means of escape. Therefore, in the event of a fire incident in the access department, the response procedures should enable the safe evacuation of the isolation patients. Documented departmental procedures should be developed for the evacuation of infectious patients. The provisions detailed below may offer a degree of fire safety to these patients for a short period of time, however in a developing fire situation evacuation will be necessary.

Negative pressure suite

3.3 Fire protection/enclosure of negative pressure suites is not normally required; however, as a dedicated extract ventilation system is required for negative pressure suites, as shown in **Figures 1 & 2**, the following provisions are necessary.

General departmental supply situation

3.4 If the supply air is derived from the adjoining department's AHU, there is potential for smoke contaminated air being drawn into the negative pressure suite via the supply ductwork. (When the fire alarm activates in the department the fire smoke dampers enclosing the department will close, therefore terminating the supply air and subsequently creating neutral pressure in the supply ducts, thus enabling smoke travel through the ducts into the suite).

3.5 The extract ventilation system should be interfaced with the department's fire alarm system, whereby the extract system will shut down on activation of a manual call point or detector within the zone/department. As noted above, this is to prevent potentially smoke contaminated air being drawn into the negative pressure suite from the adjoining area in the event of a fire within the department.

3.6 A fire alarm activation in a remote zone through which the supply air duct traverses, will cause the supply air feeding the negative pressure suite to terminate, as the appropriate fire smoke dampers to the affected zone boundaries will close. In this case the negative pressure suite extract ventilation should continue to run, as there is limited risk of smoke being drawn into the suite from the immediately adjoining area.

3.7 Extract ductwork should be considered an extension of the negative pressure suite and respective department therefore must be fire rated throughout its length. Fire dampers, where the ducts penetrate walls and floors, will not be required.

3 Fire Safety

Dedicated AHU supply situation

3.8 If the negative pressure suite has a dedicated supply AHU, then the potential for smoke being drawn in from the corridor is significantly reduced. Therefore the supply AHU and associated extract should continue to run.

3.9 Ductwork can be considered an extension of the isolation suite, therefore must be fire rated. Fire dampers, where the ducts penetrate walls and floors, will not be required.

3.10 A motorised smoke/fire damper must be fitted at the supply ductwork immediately after the AHU. The damper should close in the event of an AHU or intake fire under the control of a smoke detector mounted in ductwork immediately downstream of the AHU.

Fire rated ductwork

3.11 Where fire rated duct work breaches compartmentation it should be rated to a minimum of 60 minutes.

3.12 All fire rated ductwork must be pressure tested following the methodology set out in DW143 ‘A Practical Guide to Ductwork Leakage Testing’.

A1 Appendix 1

Appendix 1

Example room layout

Introduction

A1.1 The room layout in this appendix is intended as a guide. Other room configurations are possible. Refer to WHBN 04-01 – 'Adult in-patient accommodation' and the section on 'Single-bed room' in WHBN 00-03 – 'Clinical and clinical support spaces', which give definitive design guidance and space standards for single-bed rooms with en-suite facilities.

A1.2 For guidance on the sanitary assemblies used in these layouts, see WHBN 00-10 Part C – 'Sanitary assemblies'.

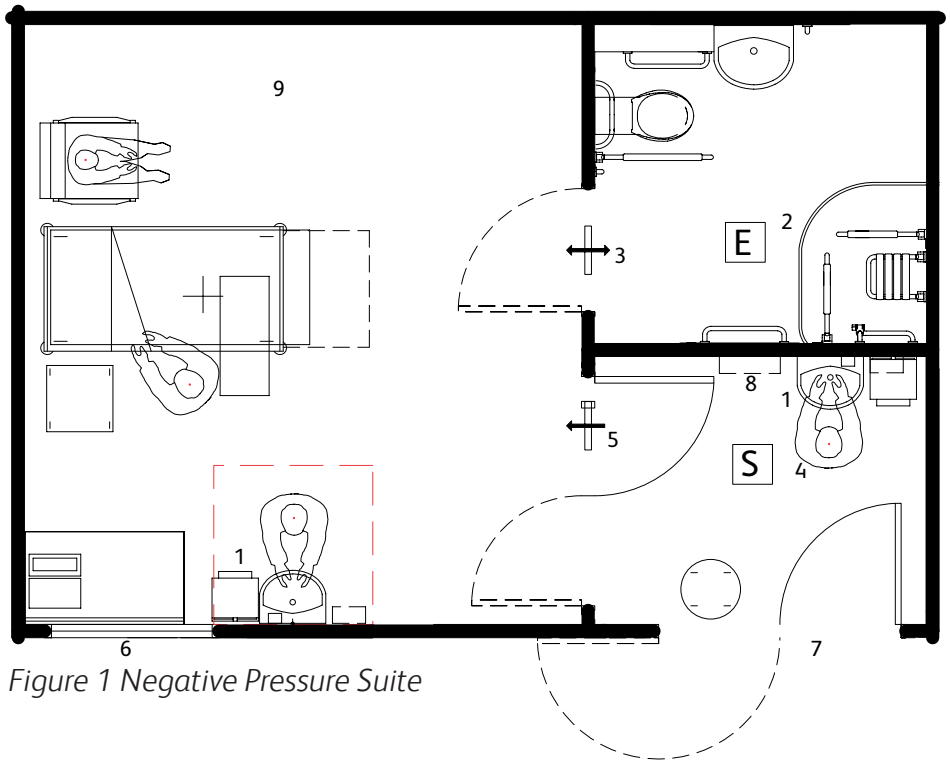

Figure 1 Negative Pressure Suite

Minimum requirements

1. Clinical wash-hand basin.
2. Provide suitable extract system.
3. Install transfer grille at low level to en-suite door.
4. Supply air.
5. Pressure stabiliser at high level.
6. Observation window in corridor wall with integral privacy blinds to allow for staff observation and patient views out.
7. Double door for personnel and bed access (with lockable leaf).
8. Disposable apron dispenser.
9. Ceiling to be sealed solid construction, external window to be sealed

A2 Appendix 2

Appendix 2

Acceptance testing of Negative Pressure Suites

Definitions

Negative Pressure Suite

A2.1 Includes the entry lobby, patient's room, en-suite facility and any storage or other area directly accessible from the patient's room or en-suite facility.

Negative Pressure Suite envelope

A2.2 The Negative Pressure Suite bounded by a solid floor, solid ceiling and full-height walls that separate it from any other adjoining space or the outside.

Validation – isolation room air permeability

A2.3 Assessment of room envelope air leakage involves establishing a pressure differential across the envelope and measuring the air flow required to achieve that differential.

A2.4 Air permeability specifications and test procedures for isolation rooms are given in BSRIA Test Standard BTS 3/2018 'Air permeability testing of isolation facilities'.

Rationale
To ensure effective isolation, it is important that air leakage to or from adjacent areas is kept to a minimum. Construction gaps should be minimised and service penetrations sealed before the room is tested. There should be NO temporary seals other than those permitted (i.e. supply and extract ducts). The test pressures are significantly more than would be achieved under a ventilation fault condition within the isolation room. When in operation, the patient's room and en-suite are designed to be at a neutral or slightly negative pressure so the actual leakage between adjoining spaces should be insignificant.

Validation and annual revalidation

Filtration test standards

A2.5 General and fine filter grades must be visually inspected to ensure that they are free from tears or other damage at the time of installation. They must be a good fit and clamped into their housing, with no obvious gaps that could allow air bypass. The filter housing must have the same integrity as the filter.

A2 Appendix 2

A2.6 High efficiency particulate air (HEPA) filters, where fitted, must be certified by their manufacturer for conformity to BS EN 1822. When installed, their performance should be checked with a particle counter using the method set out in BS EN 1822 or other approved method.

Air permeability tests

A2.7 Air permeability tests should be carried out by an independent testing company that is a member of ATTMA. Air sealers must not test their own work. The report should be as described in BSRIA document BTS 3/2018 'Air permeability testing of isolation facilities', section 5 'Test report'

A2.8 These tests must 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.

A2.9 The maximum air permeability of the isolation suite and each individual room forming part of the suite shall not exceed 2.5$m^3/(h.m^2)$ at a room test pressure of 50 Pa, as suggested in BSRIA document BTS 3/2018 'Air permeability testing of isolation facilities'.

A2.10 Further clarification, specifications and test procedures can be obtained from BSRIA Test Standard BTS3 'Air permeability testing of isolation facilities'.

A2.11 Other tests may be necessary to check particular aspects of the specific installation. Where this is necessary, reference should be made to Approved Document L2A of the Building Regulations.

System operating standard

A2.12 The room will be considered fit for purpose if, with the ventilation system operating and all doors closed, the following parameters are achieved:

- the patient's room has an air change rate of at least 10 per hour;
- the en-suite facility is at negative pressure with respect to the patient's room;
- a failure of either the supply or extract fan will be indicated at a designated nurse station and the estates department;
- there is a negative pressure of between 5 and 10 pascals between the patient room and the corridor.
- there is a negative pressure cascade from the corridor to the room.

Appendix 2

A2.15 The room and associated plant must be tested following initial commissioning and thereafter re-tested at least annually for conformity with this operating standard.

A2.16 These tests must include any pressure stabilisers and air pressure sensors.

Record-keeping

A2.17 In addition to the commissioning and annual validation records, accurate and detailed monitoring records must be kept.

A3 Appendix 3

APPENDIX 3

Welsh Health Circular WHC(2018)033 Airborne Isolation Room Requirements

R References

References

Acts and Regulations

The acts and regulations shown below can be accessed from the **http://www.legislation.gov.uk/website**

The Equality Act 2010

Air Tightness Testing and Measurement Association (ATTMA)

https://www.bcta.group/attma/

https://www.melinconsultants.co.uk/downloads/ATTMA-TSL2-non-dwellings.pdf

British Standards

https://shop.bsigroup.com/

BS 8300 Design of buildings and their approaches to meet the needs of disabled people. Code of practice

BS EN 779 Particulate air filters for general ventilation. Determination of the filtration performance

BS EN 1822 High efficiency air filters (EPA, HEPA and ULPA)

Building & Engineering Services Association (B&ES)

www.b-espublications.co.uk/Default.aspx

DW143: Guide to Good Practice – Ductwork Air Leakage Testing

https://www.thenbs.com/PublicationIndex/Documents/Details?DocId=250468

DW144: Specification for sheet metal ductwork, low,

https://www.thenbs.com/PublicationIndex/Documents/Details?DocId=306670

R References

Building Services and Information Association (BSRIA)

www.bsria.co.uk/

BTS2 Test method for pressure stabilisers (forthcoming) BTS3 Air permeability testing of isolation facilities (forthcoming)

Chartered Institution of Building Services Engineers (CIBSE)

https://www.cibse.org/

Testing buildings for air leakage TM23

Department of Health

www.gov.uk/government/organisations/department-of-health

Health and Social Care Act 2008 - The Code of Practice on the prevention and control of infections and related guidance

Health & Safety Executive (HSE)

www.hse.gov.uk/

Biological agents: Managing the risks in the laboratory and healthcare premises. Advisory Committee on Dangerous Pathogens, 2005

https://www.hse.gov.uk/aboutus/meetings/committees/acdp/050208/acdp88p6.pdf

NHS Wales Shared Services Partnership – Facilities Services

The publications below are available from the NHS Wales Shared Services Partnership – Specialist Estates Services websites:

Intranet: **http://howis.wales.nhs.uk/sites3/home.cfm?OrgID=254**

Internet: **http://www.nwssp.wales.nhs.uk/specialist-estates-services**

National standards for cleaning in NHS Wales (Intranet only)

References

Health Technical Memorandum

HTM 03-01 – Specialised ventilation for healthcare premises

Welsh Health Building Notes

WHBN 00-03 – Clinical and clinical support spaces

WHBN 00-09 – Infection control in the built environment

WHBN 00-10 Part C – Sanitary assemblies

WHBN 04-01 – Adult in-patient accommodation

Welsh Health Technical Memorandum

WHTM 05/02 – Fire safety in the design of healthcare premises

WHTM 06-01 – Electrical services supply and distribution

Welsh Government

https://gov.wales/

Building Regulations
https://gweddill.gov.wales/topics/planning/buildingregs/?lang=en

Approved Document L – Conservation of fuel and power

Approved Document M – Access to and use of building