6 HEATING, VENTILATION AND AIR-CONDITIONING

Minimum Standards

6 .1.00 The minimum requirements for the provision of heating, ventilation and air-conditioning in Health Care Facilities shall be those listed in Enclosure E2.

In addition to the minimum requirements and depending upon the type of facility and installed services the following Guidelines and Australian Standards shall apply:

- Guidelines for the Classification and Construction of Isolation Rooms in Health Care Facilities - Department of Human Services Victoria
- Guidelines for the Use of Glutaraldehyde in the Health Industry - Department of Human Services Victoria
- Energy Efficient Government Buildings - Sustainable Energy Authority Victoria
- AS 4508 - Thermal resistance of insulation for ductwork used in building air conditioning.
- AS 4343 - Pressure equipment - Hazard levels
- AS 4260 - High efficiency particulate air (HEPA) filters - Classification, construction and performance
- AS 3666.1-3 - Air handling and water systems of buildings - Microbial control
- AS 3653 - Boilers - Safety, management, combustion and other ancillary equipment
- AS/NZS 2982.1 - Laboratory design and construction - General requirements
- AS 2639 - Laminar flow cytotoxic drug safety cabinets - Installation and use
- AS 2593 - Boilers - Unattended and limited attendance
- AS 2243.3 - Safety in laboratories - Microbiological aspects and containment facilities
- AS 2243.6 - Safety in laboratories - Mechanical aspects
- AS 2243.8 - Safety in laboratories - Fume cupboards
- AS 1807 - Cleanrooms, workstations, safety cabinets and pharmaceutical isolators - Methods of test
- AS1668.1 The use of ventilation and airconditioning in buildings - Fire and smoke control in multi-compartment buildings
- AS1668.2 The use of ventilation and airconditioning in buildings - Ventilation design for indoor air contaminant control
- AS1668.3 The use of ventilation and airconditioning in buildings - Smoke control systems for large single compartments or smoke reservoirs
- AS/NZS 1677.2 Refrigerated systems - Safety requirements for fixed applications
- AS 1386.1 - Cleanrooms and workstations - Principles of clean space control
- AS 1386.4 - Cleanrooms and workstations - Non-laminar flow Cleanrooms - Class 3500
- AS 1228 - Pressure equipment - Boilers

All clauses outlined in the following section shall be in addition to statutory requirements.

General

6 .2.00 Heating includes equipment, providing heating for comfort or other purposes and can be part of an air-conditioning system.

Mechanical ventilation includes toilet and general exhaust systems, fume cupboards, biohazard cabinets, exhaust hoods, smoke management and pressure and infection control systems based on pressure and airflow direction control. Mechanical ventilation can be part of an air-conditioning system.

Air-conditioning is the process of treating air to control all or some selected parameters such as temperature, humidity, pressure, air movement pattern / velocity and cleanliness.

Refrigeration means cooling equipment for coolrooms and other not comfort related cooling purposes.

6 .3.00 Heating shall be provided and cooling is recommended to be provided for each area used by patients. Cooling is not required in any bathroom or toilet area with an exhaust system.

6 .4.00 Ducted air-conditioning systems shall be capable of providing sufficient mechanical ventilation, even if natural ventilation is available.

6 .5.00 Where loss of system performance will cause an unacceptable risk in critical areas, based on risk assessment, performance shall be maintained by duplex systems, monitored and an alarm shall be raised if performance lost.

6 .6.00 Ventilation systems in critical areas such as Operating Rooms, Recovery, CCU, ICU, Emergency Unit and Infectious Diseases Units shall operate on emergency power. All ventilation systems in areas defined as patient care in section 9a of the BCA are recommended to operate on emergency power.

6 .7.00 Access to plant rooms are recommended to not be via treatment areas. All services in occupied areas are recommended to be concealed where possible, but if exposed then arranged to limit dust and dirt build-up.

6 .8.00 All components such as temperature sensors and wall grills within an occupied space shall be suitable for swab down cleaning. (Not waterproof).

6 .9.00 Rooms containing heat producing equipment, such as boiler or heater rooms or laundries, shall be insulated and ventilated to prevent the floor surface above and/or the adjacent walls of occupied areas from exceeding a temperature of 6 degrees Celsius above ambient room temperature.

Infection Control

6 .10.00 Design principles throughout the patient care areas shall, in addition to comfort requirements, comply with infection control requirements. To minimise the risk of infection the ventilation system shall be designed and balanced to provide directional air flow from clean to less clean areas. Room pressurisation shall be maintained as prescribed in Enclosure E1 (Air Movement Relationships). This will frequently require air quantities in excess of the minimum scheduled in the Australian Standard AS 1668 Part 2, and these Guidelines.
Positive flow at adequate rates is preferred to the defining of pressure differentials between areas. In some circumstances, flow may be required only on opening of doors and the system shall have adequate flexibility to accommodate this requirement.

6 .11.00 Provision shall be made to ensure adequate air supply with varying filter resistances in areas requiring high levels of airborne contaminant control. Typically this will be in Operating Rooms, Set-up Rooms, Isolation Rooms and High Infection Risk Areas.

6 .12.00 Rooms or booths used for sputum induction, aerosolized pentamidine treatments and other high-risk cough inducing procedures shall be provided with local exhaust ventilation in addition to infection control requirements called up in these Guidelines for the classification and construction of isolation rooms in health care facilities - Department of Human Services Victoria. See enclosure E1 for ventilation requirements.

6 .13.00 Dirty linen and Dirty Utility Rooms shall be maintained at a negative air pressure relative to adjacent areas. Clean linen rooms in patient care areas shall be maintained at a positive air pressure relative to adjacent areas.

6 .14.00 If individual room recirculation (unitary fan coil) units are to be used in High Risk Areas, high efficiency filters shall be installed and additional cleaning procedures approved by the Infection Control Committee shall be implemented. Additional air handling equipment will be required to achieve the necessary clean to less clean airflow patterns.
Such areas include:
- Birthing / Delivery Rooms
- Nurseries
- Protective Isolation Rooms / Units
- Special Care Units
- Treatment Rooms
- Emergency Areas

Systems incorporating central air supply and remote filter stations are recommended for these areas.

6 .15.00 Fans in systems serving areas requiring airborne contaminant control shall be operated 24 hours per day to maintain airflow patterns from clean to less clean areas.

6 .16.00 Air-conditioning systems shall maintain fresh air, temperature, humidity and contaminant control (dust, micro-organisms and gases) of the air within prescribed limits

6 .17.00 Infectious diseases isolation and treatment rooms shall have negative pressure ventilation and shall be in accordance with the Guidelines for the classification and construction of Isolation Rooms in health care facilities - Department of Human Services - Victoria.

Outside Design Conditions

6 .18.00 Outside design conditions shall be based on the most accurate climatic data available for the location of the proposed project.

6 .19.00 Outside design conditions shall be selected as follows:

- For the locations listed in AIRAH - ACS Design Aid DA9a: Air conditioning systems - Design Temperature Data (2). For Operating Unit plants and Critical Care Areas use the 'Critical Process', 24 hour data if available for the location, otherwise use the 'Comfort or Non Critical' data with appropriate allowance.

  For all other plants use the 'Comfort or Non Critical Process Installations' data.

- For locations not listed in Design Temperature Data (2) use data for the nearest listed location having similar climatic characteristics. The data in reference Design Temperature Data (2) has been prepared by the Bureau of Meteorology from their archives for hundreds of locations in Australia and as such it represents a significant increase in the accuracy of data compared with what was available previously.

Room Design Conditions

6 .20.00 Room design conditions are summarised in Enclosure E1. Table 1 contains:

- Air movement (pressure difference) relationship between rooms
- Minimum outdoor air requirements
- Minimum air changes per hour
- 100% exhaust requirements
- Minimum filtration requirements
- Prohibition of air recirculation by room units
- Relative humidity
- Room design temperature.

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6 .21.00 The temperature at 1.5 metres above the floor in a room shall not vary by more than 1 degree Celsius. The temperature difference between rooms on the same zone shall vary by not more than 3 degrees Celsius. The temperature difference between floor level and 1.5 metres above the floor shall be not more than 1.5 degrees Celsius. The temperature of the floor shall be within the range 19 degrees Celsius to 26 degrees Celsius.

6 .22.00 Average air velocity in the room shall be between 0.1 and 0.15 m/s. Particular care with the design of air distribution is required in Operating Rooms and rooms where patients are on beds and trolleys such as Patient Bed Rooms, Recovery, Emergency and Critical Care. Under no circumstances shall the supply air rate be less than 6 ACHR in any room any time. This applies to minimum air quantities on variable air volume systems as well as to constant volume systems.

6 .23.00 Evaporative cooling shall be designed to maintain acceptable indoor comfort conditions, based on heat stress index or similar criteria.

Room Design Conditions

6 .24.00 Zoning of air handling plant shall be provided to the extent required to limit the temperature difference between rooms served by the same zone to a maximum of 3 degrees Celsius.

Heating

6 .25.00 All occupied areas shall be heated.

6 .26.00 Central heating plants are recommended to consist of a minimum of two adequately selected heating units, furnaces or boilers, to provide standby in the event of failure or maintenance of one heating unit.

6 .27.00 Open fires, portable heaters and unflued gas heaters shall not be installed in patient areas.

6 .28.00 Boiler accessories including feed pumps, heat circulating pumps, condensate return pumps, fuel oil pumps, and waste heat boilers shall be connected and installed to provide both normal and standby service.

6 .29.00 Heating systems shall be thermostatically controlled. Heating systems with long thermal lag, for example, most types of in-slab heating, shall only be used when there is no alternative. These systems shall incorporate a control system to hold space temperature within 2 degrees Celsius of the winter design value. Temperature control that relies on opening windows to compensate for over heating shall not be used. The surface temperature of heating equipment in occupied areas shall not exceed 50 degrees Celsius. The temperature at floor level shall not deviate by more than 1.5 degrees Celsius above the air temperature at a height of 1.5 metres.

Cooling

6 .30.00 Cooling tower and evaporative condenser systems shall be designed and installed in accordance with the Health (Legionella) Regulations and AS 3666 - Air handling and water systems of buildings - Microbial control.

6 .31.00 Cooling towers and evaporative condensers shall include a side stream filter or cyclonic separator system to provide solids removals from the circulating water systems.

6 .32.00 Evaporative cooling may be used for support areas where relief cooling only is required such as kitchens and workshops and some other non-critical areas, where suitable. Observe standards and codes for design as for air-conditioning.

6 .33.00 Central cooling plant chiller sets shall be selected to ensure that in the event of failure of a compressor, adequate standby capacity is available for selected critical areas. Select chillers that maintain reliable, energy efficient low-load operation.

Ventilation - Outdoor Air

6 .34.00 Outside air shall be provided according to AS1668 Part 2 as adopted by the BCA. Enclosure E1 contains data from AS 1668 Part 2 with the addition of data on areas of hospitals not covered by the standard. Enclosure E1 shall be used as a supplement to Table A1 of AS 1668 and be read in conjunction with the Standard.

In areas where there are high people densities, the actual number of people in the space shall be used. It should be noted that values in AS 1668 for areas such as the Staff Cafeteria yield more people than is normal for such spaces in hospitals.

6 .35.00 All ventilation systems shall be designed to control the high level of odours often generated within Health Care Facilities.

6 .36.00 All bathroom and toilet exhaust systems shall be fully ducted and discharge to outside, not to common roof or ceiling space.

6 .37.00 Variable volume supply air systems shall incorporate control devices to ensure minimum outdoor air supply to all areas is maintained at all times.

6 .38.00 Regardless of whether the area is served via operable windows, forced fresh air shall be provided in accordance with these guidelines to all air-conditioned occupied spaces.

6 .39.00 Sanitary compartments, Dirty Utility Rooms and similar spaces shall not be ventilated by a system which also serves areas such as Operating Rooms.

6 .40.00 Ventilation systems for rooms where ethylene oxide (ETO) sterilizers are used and ETO store shall be designed in accordance with the Occupational Health and Safety section of these Guidelines. Upon loss of exhaust system airflow, an audible and visual alarm shall activate in the steriliser work area, and at a location that is continually staffed.

6 .41.00 Where conditions permit, natural ventilation may be used, for non-patient areas such as boiler rooms and central storage.

Ventilation - Exhaust Air

6 .42.00 Contaminated exhaust systems, including those serving toilets, and those necessary to attain positive air flow from clean to dirty areas shall be provided with duplex fans or fan motors and automatic change over from duty to standby in the event of a failure of the fan or motor. Alternatively, single motor fan systems are recommended to be fitted with differential pressure switches, to provide remote alarm indication of fan failure. This shall not apply to independent toilet exhaust systems serving single use toilet/shower or bath areas.

Ventilation - Exhaust Air

6 .43.00 Each space routinely used for administering inhalation anaesthesia and inhalation analgesia shall be served by a scavenging system to vent waste gases. If a vacuum system is used, the gas collecting system shall be arranged so that it does not disturb patients' respiratory systems. Gases from the scavenging systems shall be exhausted directly to the outside.

Anaesthesia evacuation systems may be combined with the room exhaust systems, provided that the component used for anaesthesia gas scavenging exhausts directly to the outside and does not recirculate. Scavenging systems are not required for areas where gases are used only occasionally, such as emergency rooms and offices for outline dental work. Acceptable concentrations of anaesthetising agents are unknown at this time. The absence of specific data makes it difficult to set specific standards. However, any scavenging system is recommended to be designed to remove as much of the gas as possible from the room environment. It is assumed that anaesthetising equipment will be selected and maintained to minimise leakage and contamination of room air. (Refer also to the Occupational Health and Safety requirements in these Guidelines).

Air Handling Systems

6 .44.00 In selecting air handling system types, consideration shall be given to the cost and ease of maintaining the systems. Points to be considered include:

- Plant and components located over occupied areas shall be installed in a manner so that routine maintenance does not cause disruption to normal hospital activities; in this respect plant is recommended to not, for example, be located in ceilings over patient beds
- The level of maintenance expertise available on site and the level of technical expertise available to the hospital to operate and adjust the system
- Preference shall be given to simple systems requiring simple maintenance and adjustment with extended periods between routine maintenance.

6 .45.00 All supply air, return air and exhaust shall be fully ducted in areas defined as Patient Care Areas in section 9a of the BCA.

6 .46.00 Plant room ventilation supply air shall be filtered.

6 .47.00 The bottoms of ventilation (supply / return) openings shall be at least 75 mm above the floor.

Air Handling Systems

6 .48.00 Humidifier systems shall comply with the following requirements:
- Humidification shall be achieved by the direct injection of low pressure steam into the supply air stream; where reticulated steam is not available an electrode type humidifier shall be used.
- Ducting surrounding the humidifier discharge shall be constructed to minimise the possibility of corrosion by using materials such as copper or grade 321 stainless steel, for a distance of 1500 mm downstream and 500 mm upstream of the unit.
- The base of the humidifier duct shall be graded into an open tundish through a trap next to the outlet.
- An electrical interlock shall be provided so that the humidifier can operate only when the supply air fan is operating.
- If duct humidifiers are located upstream of the final filter, they shall be located at least 4.5 metres upstream of the final filters.
- Ductwork with duct mounted humidifiers shall have a means of water removal.
- An adjustable high-limit humidistat shall be located downstream of the humidifier to reduce the potential of condensation inside the duct.
- All duct take-offs are recommended to be far enough downstream of the humidifier to ensure complete moisture absorption.
- Reservoir type water spray or evaporative pan humidifiers shall not be used.
- Duct lining shall not be installed within 4.5 metres downstream of humidifiers.

6 .49.00 Supply air and exhaust air grilles shall be made of non-corrodible material, for example, anodised aluminium section. Supply air ducting shall be designed and manufactured to prevent possible induction of contaminated air.

6 .50.00 Air handling duct systems shall be designed to be accessible for duct cleaning.

Access panels shall be fitted at each reheat coil and fire and smoke damper to allow annual Essential Services inspection

6 .51.00 Duct insulation shall be external to the duct to allow internal cleaning where required.

6 .52.00 Duct acoustic treatment and equipment such as fan coil units, conditioners and VAV boxes incorporating fibrous insulating materials shall not have fibres exposed to the airstream. Perforated facing shall have impervious linings.

6 .53.00 All duct work of air-conditioning systems and ventilation systems which supply or recirculate air shall comply with the following requirements:
- No internal lining
- Reasonable access for low frequency cleaning without need for major works
- Attenuators to have impervious lining between facing and acoustic lining
- Attenuators shall be readily removable and located within plant rooms and other accessible areas that facilitate easy removal.

6 .54.00 Air handling units and air-conditioning units in Level 1 and 2 hospitals shall comply with the following:-
- Accessible and cleanable as per AS 3666 - Air handling and water systems of buildings
- Internal lining shall have impervious facing on the air side

Air Handling Systems

6 .55.00 Air handling units and air-conditioning units in Level 3 and above hospitals shall comply with the following:

- Easy door/hatch access and space to all internal areas of units for inspection, maintenance and cleaning; door access required where size permits.
- No internal lining
- All internal surfaces to be hygienic and cleanable such as powder coat finish, stainless steel or high quality paint finish
- Internal lights shall be installed in all units over 3000 l/s airflow
- Condensate trays to be well sloped to drain with no water retention in tray and constructed of corrosion resistant materials
- All sections downstream of filters that operate below ambient pressure shall be sealed to prevent air leakage.

6 .56.00 In psychiatric patient rooms ceiling mounted air devices shall be of a secure type.

6 .57.00 Duct linings exposed to air movement shall not be used in ducts serving Operating Rooms, Birthing/ Delivery rooms, Labour/ Delivery Rooms, Nurseries, Protective Environment Rooms and Critical Care Units. This requirement shall not apply to mixing boxes and acoustical traps that have special coverings over such lining.

6 .58.00 Filter frames shall be durable and dimensioned to provide an airtight fit with the enclosing ducting. All joints between filter segments and the enclosing ducting shall be fitted with a gasket or sealed to provide a positive seal against air leakage. A manometer is recommended to be installed across each filter.

Air Filtration

6 .59.00 Heating, ventilation and air-conditioning systems shall control the concentration of air-borne particulates in High Risk Areas to minimise the risk of infection by means of air pressure, flow control and air filtration. The level of control shall be proportional with the risk.

6 .60.00 Air filtration efficiencies shall be as specified in Enclosure E1. (Refer also to Chapter 'Room / Area Specific Requirements'.

Filtration efficiency ratings are based on average efficiency according to AS 1324 - 'Air filters for use in general ventilation and air-conditioning' and AS 4260 - 'High efficiency particulate air (HEPA) filters - Classification, construction and performance'.

Control Systems

6 .61.00 All adjustable controls such as thermostats are recommended to be provided with locking covers to prevent tampering.

6 .62.00 Provision shall be made to operate the air-conditioning system within the required temperature and humidity range prescribed in Enclosure E1. The range may need to be adjusted to suit local preference or medical needs, when, for instance elderly patients and babies may require higher temperature.

Energy Conservation and Management

6 .63.00 Energy conservation design shall not compromise infection control systems. The requirements of AS 4187 shall be maintained in respect of ambient conditions for sterile stock.

6 .64.00 It may be practical in many areas to reduce or shut down mechanical ventilation during appropriate climatic and patient-care conditions and to use open windows for ventilation.

6 .65.00 Each mechanical ventilation system supply or exhaust is recommended to be equipped with a readily accessible means of either shut-off or volume reduction.

6 .66.00 To conserve energy when Operating Rooms are not in use, low air flow modes of operation can be used. Systems that maintain correct pressure gradients at lower flow rates, however, have greater temperature throttling ranges. Heating and cooling can be shut down during extended periods of non use provided supply air fans are left running. An over-ride system shall be installed to enable out of hours operation of heating and cooling.

6 .67.00 Air-handling systems shall be arranged to allow the closing down of whole non critical or high risk areas at times of low occupancy. The air-conditioning system shall incorporate sufficient separation of air handling systems, zoning for temperature control and smoke exhaust mode operation to maintain conditions when common air-handling plant is used.

The requirements of Energy Efficient Government Buildings - Sustainable Energy Authority Victoria should be incorporated into all aspects of the design and construction whenever possible.

Occupational Health and Safety

6 .68.00 Where Ethylene Oxide (ETO) is used for sterilisation:

- ETO steriliser installations shall be designed, installed, operated and maintained in accordance with AS 2647 Biological Safety Cabinets
- Sterilisation operations involving ETO shall be isolated from all non-ETO work areas
- Fan blades and other associated components of the ventilation system shall be made of non-sparking material
- Local exhaust inlets shall be located at areas close to the steriliser and aerators
- The installation design shall ensure that gases are pulled away from the operator when the door of the steriliser is opened
- Exhaust air shall not be discharged into any work area or into the general environment without decontamination or decomposition by using a Catalytic Converter or other equivalent.

6 .69.00 Cooling shall be provided on the following basis:

- If natural ventilation is proven to be inadequate, laundries and workshops shall be cooled using ducted evaporative cooling systems.
- Depending on the proximity and the intensity of the heat source to a person, spot cooling may be required. Kitchens are recommended to be served by evaporative cooling systems with facilities for tempering the supply air during winter months or be fully air conditioned if it is a cook-chill facility.

6 .70.00 Ducts which penetrate shielded rooms such as an X-ray Room shall not impair the effectiveness of the protection.

Occupational Health and Safety

6 .71.00 Dark Rooms or any film processing area shall be provided with sufficient mechanical exhaust capable of removing any vapour released from the process.

6 .72.00 Surgical plume generated during laser and diathermy use shall be exhausted. Surgical plume contains tissue particles, carbon debris, hazardous chemicals, and bacterial and viral particulates and presents a potential hazard to the health of personnel in the Operating Room.

6 .73.00 Occupational Health and Safety (Noise) Regulations shall be fully complied with in all plantrooms, workshops and areas where noise levels exceed those required by the regulations. Certification shall be provided showing compliance.

6 .74.00 Occupational Health and Safety (Plant) Regulations shall be fully complied with in all respects. Certification shall be provided showing compliance.

Operating Units

6 .75.00 SUPPLY AIR
Supply air to Operating Rooms shall be delivered at high level in a way that minimises recirculation of potentially contaminated room air and provides the cleanest practical air supply over the operating table area. The directions of air flows within Operating Units shall always be from the Operating Room and Set-up Room, through immediately adjacent inner anterooms, Scrub-up and Anaesthetic rooms to the Entrance Foyer, Recovery, Changing and post operative Clean-up Rooms; from clean to less clean areas.

Graduated pressurisation relative to pressure in areas adjacent to the Operating Unit ranging from not less than 10 Pascal positive in the Operating Room/s to slightly positive pressure in areas like Entrance Foyer, Recovery and Change Rooms and slightly negative in Clean-up Room/s can be achieved by using carefully balanced supply air and exhaust air systems. (Refer to Enclosure E1 for details of pressurisation requirement).

6 .76.00 Total circulated air quantity shall be not less than 20 air changes per hour when the supply air filters are at their maximum pressure drop of which a minimum of 50% shall be outdoor air.

6 .77.00 Airflow into the Operating Unit shall be by means of a distribution system that provides a flow of clean supply air over the operating area first then away. Entry of air shall be from the ceiling to deliver a downward air movement with a minimum velocity 0.2 m/s at the level of the operating table.

The barrier effect caused by air movement and not the actual pressure difference is important. As the pressure differentials are relatively small, the preferred method for setting up the air flow is for the total of return and exhaust air to be in the order of 150 l/s to 200 l/s less than supply air with all doors and openings closed. Different designs of Operating Rooms may require some variance in the bleed air quantity. Active control of the pressure difference is not necessary, however, supply air fans are required to be selected so as to maintain constant air quantity as filter resistance increases. This can be achieved by selecting good fan curve characteristics or controls measuring supply air quantity and controlling fan speed to maintain supply air quantity. Air not exhaust or spilled outward from high risk areas may be recycled as return air.

Operating Units

6 .78.00 Room relative humidity shall be maintained within the range of 30% to 60% relative humidity (RH), except when flammable agents are used, in which case the requirement of AS 1169 - 'Minimizing of combustion hazards arising from the medical use of flammable anaesthetic agents' - is to maintain relative humidity above 55% and noted in Enclosure E1. Where humidifiers are used they shall be of the steam type and shall comply to the requirements of clause 6.48.00. Limiting humidity range by cooling coil design is acceptable unless there is a specific surgical requirement to warrant precise control of humidity.

6 .79.00 The Operating Room temperature shall be adjustable to suit the requirements of the procedure in progress. The temperature adjustment range is recommended to be 16 degrees Celsius to 24 degrees Celsius. The proposed function of the room will determine what degree of adjustment is provided.

To enable individual temperature, infection and odour control, each Operating Room or pair of Operating Rooms shall be served by a dedicated air-conditioning unit which may also serve that Operating Room's adjacent sterile support rooms.

6 .80.00 EXHAUST ARRANGEMENT
Exhaust registers shall be located so that the whole room is effectively scavenged, particularly at floor level. Special arrangement such as provision of balanced counter weighted flap to each low level exhaust point shall be installed to prevent an outflow of air from an exhaust point due to adverse air pressure when opening any of the Operating Room doors. The consultant shall account for the adverse effect of air flow pattern near the surgical field created by surgical lamps due to their shape, size location and the heat generated by the lamps. Operating Rooms for special procedures such as orthopaedic surgery, organ transplants or total joint replacement may require the provision of an Ultra Clean Air (UCA) system to suit their intended use.

6 .81.00 Extraction of relief air and, if incorporated, return air shall be located at low to mid level. Supply air outlets shall be located directly above the operating table. Exhaust / relief air shall be extracted at a point as close as possible to the anaesthetic delivery trolley to remove anaesthetic gas leakages from the work area whilst ensuring good airflow through the room. Low level exhaust shall be extracted at 200 mm above floor level.

6 .82.00 Low level exhaust and other provisions in accordance with AS 1169 - 'Minimizing of combustion hazards arising from the medical use of flammable anaesthetic agents', shall generally be provided where flammable anaesthetics are used. Where full provision is not made in accordance with AS1169, Operating Rooms shall have a notice, affixed as required, indication that flammable agents must not be used. Further, nitrous oxide shall not be used where low level exhaust is not provided and the range of surgical procedures undertaken in the Operating Room restricted accordingly.

6 .83.00 DESIGN REQUIREMENTS FOR UCA SYSTEMS
UCA systems shall provide sufficient filtered air moving in the correct direction to efficiently remove the bacteria dispersed by the operating team. The air flowing from the final filter shall contain not more than 0.5 Colony Forming Units per cubic metre of air (CFU/m3).

Operating Units

6 .84.00 AIR FLOW
Down flow system: the air flow at one metre from the supply air outlet shall have a minimum average velocity of 0.35m/s and at working height, not less than 0.3m/s.

Cross flow system; The minimum average velocity shall be 0.4m/s measured one metre from the filter or diffuser face.

The siting of the return air grills shall not cause short circuiting of the supply air. The control instrumentation shall include the indication of:
- Operating status such as 'in use' or 'not in use'
- Terminal filter pressure differential
- System Purging
- UCA systems.

6 .85.00 Where procedures such as organ transplants justify special designs, installation shall meet performance needs as determined by applicable Australian Standards. These special designs are recommended to be reviewed on a case by case basis.

6 .86.00 Engineering requirements for Orthodontic Operating Rooms shall be the same as for General Operating Rooms.

6 .87.00 Operating rooms where lasers are being used shall have adequate suction / evacuation controls for the plume generated.

Procedure, Recovery, Delivery and Dental Rooms

6 .88.00 Procedure Rooms in which the administration or aspiration of gaseous anaesthetics or analgesics are carried out, shall have adequate ventilation to ensure that the level of gaseous contamination does not rise above a maximum acceptable level. The utilization of a scavenge system is acceptable. Local extraction of patient exhaled anaesthetic gas at source is strongly recommended. This becomes a mandatory requirement and shall be provided where measured levels of anaesthetic gas within the area are considered excessive by the Hospital's Occupational Health and Safety Committee.

6 .89.00 Total air circulation shall be not less than 10 ACHR of which the minimum outside air supply shall be the greater of 20 l/s per person or 2 air changes per hour. Alternatively, localised exhaust shall be provided at each bed achieving a minimum of 50 l/s exhaust per bed.

6 .90.00 Cupboards containing anaesthetic machines shall be ventilated to remove the build-up of nitrous oxide within the cabinet.

Bronchoscopy and Sputum Induction Unit/s

6 .91.00 Supply air to Bronchoscopy and Sputum Induction Units shall be delivered at high level in a way that minimises recirculation of potentially contaminated room air and provides the cleanest practical air supply over the procedure area. The directions of air flows within the Procedure Room shall always be from clean to less clean areas.

Bronchoscopy and Sputum Induction Unit/s

6 .92.00 Total circulated air quantity shall not be less than 12 ACHR when the supply air filters are at their maximum pressure drop of which a minimum of 25 % shall be outdoor air. Room air shall not be recirculated. Procedure Rooms and Recovery Rooms shall be maintained at a negative pressure in relation to adjacent areas. Design and construction shall be in accordance with the requirements in Guidelines for the classification and Design of Isolation Rooms in Health Care Facilities published by the Department of Human Services Victoria. A minimum filtration efficiency of F8 air filters shall be installed.

6 .93.00 Rooms or booths used for Bronchoscopy, Sputum Induction, aerosolized pentamidine treatments and other high risk cough-inducing procedures shall be provided with local exhaust ventilation.

Cardiac Catheterisation Unit/s

6 .94.00 Supply air to Cardiac Catheterisation Units shall be delivered at high level in a way that minimises recirculation of potentially contaminated room air and provides the cleanest practical air supply over the procedure area. The directions of air flows within the Procedure Room shall always be from clean to less clean areas. Graduated pressurisation relative to pressure in areas adjacent to the Procedure Room can be achieved by introducing 10 % more supply air than exhaust air. Recirculated room air-conditioning shall not be used.

Total circulated air quantity shall be not less than 15 ACHR when the supply air filters are at their maximum pressure drop of which a minimum of 20% shall be outdoor air. A minimum filtration efficiency of F9 air filters shall be installed.

Endoscopy Units

6 .95.00 Where manual endoscopes disinfection with glutaraldehyde occurs, the endoscopes and disinfection trays shall be contained by a system of local exhaust ventilation capable of providing adequate capture of contaminants in accordance with Department of Human Services Guidelines for the Use of Glutaraldehyde in the Health Industry. Recirculated filtered air systems shall not be used. A fume cupboard type hood with a sliding sash shall be provided. This hood is recommended to incorporate a perforated supply air plenum at the top and down draft slots and plenum exhaust to the sinks. Ventilation in workrooms where endoscopes are cleaned shall achieve a minimum of 15 air changes per hour

When a hood is installed in an Operating Unit between the Clean-Up and Set-Up Rooms, it shall be of pass-through design with interlocked sliding sashes. The relative positive pressurisation of the Suite shall not be adversely affected when either door is open.

Alternatively, complete manual disinfection of scopes may be carried out in a dedicated scope disinfection room equipped with a down draft trough with perimeter exhaust slots exhausting at a rate sufficient to contain fumes.

Endoscopy Units

6 .96.00 Manual disinfection of fiberoptic endoscopes is recommended to be carried out in a dedicated endoscope disinfection room equipped with a down draft trough with perimeter exhaust slots, exhausting at a rate sufficient to contain fumes.

Where automatic or semi-automatic disinfectors are used, a localised exhaust system shall be provided to achieve appropriate capture and removal of contaminated air. Fumes shall be drawn away from the operator's work position. Machine mounted filters are not always sufficient and require monitoring.

6 .97.00 Fiberoptic endoscopes storage cupboards shall be mechanically vented with an exhaust system to remove glutaraldehyde residuals.

Sterile Supply Services

6 .98.00 Sterile Supply Services shall be air-conditioned with a minimum of 10 ACHR. Air movement and ventilation shall achieve a positive airflow from clean to contaminated work areas. Ventilation rates shall be maintained when the zone is not occupied sufficient to ensure dilution rates are maintained.

Isolation Rooms

6 .99.00 Isolation Rooms shall be designed and installed in accordance with the requirement of Guidelines for the Classification and Design of Isolation Rooms in Health Care Facilities published by the Department of Human Services.

Alternating pressure (reversible airflow) isolation rooms shall not be installed or used.

Isolation Rooms

6 .100.00 Isolation Room design and installation shall comply with the following tables:

FEATURE	Class S	Class N	Class P
SEALED ROOM WITH ADJUSTABLE DOOR GRILLE		Yes	Yes
> OR = 12 AIR CHANGES PER HOUR PER PATIENT OR 145 L/S MINIMUM		Yes	Yes
100 % FRESH AIR		Yes	
PROVISION TO INCREASE FAN SPEED		Yes	Yes
CONSTANT VOLUME SUPPLY AIR SYSTEMS	Yes	Yes	Yes
15 PA PRESSURE GRADIENT STEPS: CORRIDOR, ANTE-ROOM & ROOM		Yes	Yes
SEAL ROOM AIR-TIGHT		Yes	Yes
LOCAL FAN FAIL ALARM		Yes	Yes
FANS/ ALARMS ON ESSENTIAL ELECTRICAL SUPPLY		Yes	Yes
DIFFERENTIAL PRESSURE MONITORING		Yes	Yes
INDEPENDENT SUPPLY AIR		Yes	
HEPA FILTERS ON SUPPLY AIR			Yes
LOW LEVEL EXHAUSTS		Yes	Yes
BACK DRAUGHT PREVENTION ON COMMON DUCTS		Yes	
INDEPENDENT EXHAUST		Yes	
EXHAUST DUCT UNDER NEGATIVE PRESSURE WITHIN BUILDING		Yes	
HEPA FILTERS ON EXHAUST		Yes	Yes

6 .101.00 Isolation Room Pressure Gradients:

ROOM TYPE	Room	Ensuite	Anteroom
CLASS N	-30 Pa	-15 Pa	-15 Pa
CLASS P	+30 Pa	+15 Pa	+15 Pa
CLASS P WITH NEGATIVE PRESSURE ANTEROOM	+15 Pa	+15 Pa	-15 Pa

Pathology, Autopsy and Body Holding

6 .102.00 Systems serving Pathology Areas shall be independent of other systems. Exhaust from these areas shall be designed not to create any harmful effect to occupants or contamination to any adjacent areas.

Pathology, Autopsy and Body Holding

6 .103.00 Supply air and exhaust serving autopsy and dissection areas shall be designed to protect personnel undertaking procedures and be discharged in a manner that will not contaminate any adjacent area or system.

6 .104.00 Requirements for facilities that conduct autopsies include:-

- Single pass air-conditioning utilising 100% exhaust of all air
- Exhaust intakes arranged to provide maximum fume and odour removal with protection of personnel
- Operate the room at negative pressure in relation to adjacent areas
- If necessary filter exhausted air with carbon filters
- Install down-draught or back-draught exhaust
- Back-draught exhaust shall have a minimum face velocity of 2.5 m/s.

Note: The above is for facilities which undertake regular autopsies.

Pharmacy, IV Additive and Cytotoxic Suites

6 .105.00 Laboratory and Dispensing Areas in Pharmacy shall be investigated for the necessity to control air flow and exhaust to avoid any possibility of contamination to any adjacent areas.

6 .106.00 Cytotoxic Suites shall be designed and constructed in accordance with AS 2639 'Laminar flow cytotoxic drug safety cabinets - Installation and use'. The basic design shall be that of a Class 350 Cleanroom varied in accordance with the requirements of AS 2639.

Laboratories and Clean Rooms

6 .107.00 Laboratory Areas and Dispensing Areas in Pharmacy shall be designed to comply with AS/NZS 2982.1 'Laboratory design and construction - General requirements' and AS 2243.8 'Safety in Laboratories - Fume cupboards'.

6 .108.00 Physical Containment (PC) laboratories shall be designed and constructed according to the requirements of the Genetic Manipulation Advisory Committee publication 'Guidelines for Small Scale Genetic Manipulation Work' when any work involving genetic manipulation is undertaken.

Dark Rooms and Film Processing Areas

6 .109.00 Air spill shall not occur from the Dark Room to adjacent spaces. Dark Room exhaust shall balance or exceed supply and shall be balanced considering equipment connected exhaust systems.

6 .110.00 Daylight processing equipment shall be provided with adequate local exhaust ventilation to prevent the uncontrolled escape of chemical emissions. Fumes or potentially contaminated air shall be exhausted to outside air and not recirculated.

6 .111.00 Special ventilation requirements shall be dependent upon the type of film processor (automatic or manual) to be installed in an X-ray Dark Room, Processing and Viewing Areas. Adequate ventilation is required to contain the uncontrolled spread of fumes from potentially harmful chemicals into occupied spaces.

Dark Rooms and Film Processing Areas

6 .112.00 Through-the-wall processors require local exhaust ventilation to each side of the wall. Most processors also require indirect connection of the drier fan discharge to an exhaust system, in addition to general room exhaust for fumes emitted from stored chemicals and the machine cleaning process. Ventilation shall be provided to film processors in accordance with the manufacturers' recommendations.

6 .113.00 If remote chemical mixing, reticulated chemical supply and silver reclaiming is utilised, the chemical mixing tank or silver reclaiming unit shall be contained within a ducted enclosure, connected to an exhaust system as described above.

6 .114.00 Local exhaust ventilation shall be provided above sink units used in connection with the regular cleaning of X-ray processor equipment components.

6 .115.00 Work areas and enclosures used in connection with the manual processing of x-ray film such as dental clinics, shall be provided with dilution ventilation and temperature controls to prevent the build up of fumes.

6 .116.00 Vapour emissions from tundishes into which liquid photographic waste discharges shall be controlled.

6 .117.00 Ducts that penetrate construction intended to protect against X-ray, magnetic, Radio Frequency Interference, or other radiation shall not impair the effectiveness of the shielding protection.

Podiatry, Prosthetics, Dental & Orthodontic Workshops

6 .118.00 Fresh air, ventilation and air-conditioning systems shall be provided with a minimum supply air quantity of 20 litres per second per square metre of facility floor space. Extraction shall be localised as close as practicable to the sources of contamination identified above. Exhausts from this area shall be suitably filtered and discharged in a manner that will not contaminate any adjacent area or system. Capture velocities at the point of localised extraction shall exceed 2 m/s. Consideration is recommended to be given to acoustics to prevent noise nuisance.

6 .119.00 Fume cupboards complying with AS 2242.8 'Safety in Laboratories - Fume cupboards' shall be installed in chemical mixing areas.

Linen Processing Areas

6 .120.00 Air filtration, mechanical ventilation and air-conditioning systems servicing linen processing areas shall be designed to ensure appropriate lint and dust control. Mechanical ventilation systems shall be designed to remove the heat generated by laundry drying processes utilising systems such as exhaust registers over the dryers or dryers ducted direct to outside air with lint collection provision on all exhaust discharges. Provision shall be made for regular maintenance to prevent the excessive build up of lint which can be the source of a fire hazard.

Linen Processing Areas

6 .121.00 Spot cooling with air-conditioned or evaporative cooled supply air is recommended to be considered to provide adequate operator comfort in laundries.

6 .122.00 Ventilation shall be provided in accordance with AS1668 Part 2 'Mechanical ventilation for acceptable indoor-air quality'. Where air-conditioning is installed, a minimum of 25 ACHR is recommended. For evaporative cooling a minimum of 36 ACHR is recommended. Airflow shall be from clean to less clean areas.

6 .123.00 Soiled linen rooms shall be exhausted through a dedicated exhaust system to reduce the risk of cross infection.

6 .124.00 The Clean Linen Store shall be supplied with clean, filtered air. Air pressure shall be positive in respect to the rest of the Laundry.

6 .125.00 Air conditioning shall be installed to reduce the moisture content of linen.

Noise and Acoustic Attenuation

6 .126.00 Noise levels in any area shall not exceed the exposure standard established in the Occupational Health and Safety (Noise) Regulations. For the purposes of the regulations, the exposure standard means the eight (8) hour equivalent continuous sound pressure level of 85 dB(A) measured in A-weighted decibels referenced to 20 micro Pascals. Due consideration shall be given to the amplification of noise due to multiple sound sources to ensure the exposure standard is not exceeded.

6 .127.00 Noise breakout from any plant areas shall not exceed the values for interior noise as determined in AS 2107 - 'Acoustics - Recommended design sound levels and reverberation times for building interiors'. Due consideration shall be given to exterior noise levels to prevent nuisance to the external environment by noise generated by plant.

Mental Health Units

6 .128.00 Consideration shall be given to the type of heating and cooling units, ventilation outlets, and equipment installed in patient occupied areas of Mental Health Units. Special purpose equipment designed for psychiatric or prison use shall be used to minimise opportunities for self harm. The following shall apply:

- All air grilles and diffusers shall be of a type that prohibits the insertion of foreign objects
- All exposed fasteners shall be tamper-resistant
- All convector or HVAC enclosures exposed in the room shall be constructed with rounded corners and shall have closures fastened with tamper-resistant screws
- HVAC equipment shall be of a type that minimises the need for maintenance within the room.