Engineering

Technical Standard

TS 0245 - Design Requirements for Ventilation and Cooling Systems

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Application and Interpretation of this Document

It is the responsibility of the users of this Standard to ensure that the application of information is appropriate and that any designs based on this Standard are fit for SA Water's purposes and comply with all relevant Australian Standards, Acts and regulations.

Users of this Standard accept sole responsibility for interpretation and use of the information contained in this Standard. Users should independently verify the accuracy, fitness for purpose and application of information contained in this Standard.

Only the current revision of this Standard should be used which is available for download from the SA Water website.

Significant/Major Changes Incorporated in This Edition

This is the first issue of this Technical Standard.

Document Controls

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1 Introduction

SA Water is responsible for operation and maintenance of an extensive amount of engineering infrastructure.

This standard has been developed to assist in the design, maintenance, construction, and management of this infrastructure.

1.1 Purpose

The purpose of this standard is to detail minimum requirements to ensure that assets covered by the scope of this standard are constructed and maintained to consistent standards and attain the required asset life.

1.2 Glossary

The following glossary items are used in this document:

Term	Description
BCA	Building Code of Australia
ESD	Environmentally Sustainable Design
HVAC	Heating, ventilation, and air conditioning
MEPS	Minimum Energy Performance Standards
NCC	National Construction Code
SA Water	South Australian Water Corporation
SCADA	Supervisory Control and Data Acquisition
TG	SA Water Technical Guideline
TS	SA Water Technical Standard

1.3 References

1.3.1 Australian and International

The following table identifies Australian and International standards and other similar documents referenced in this document:

Number	Title
	National Construction Code, Building Code of Australia
AIRAH-DA09	Air Conditioning load estimation
ASHRAE 55	Thermal Environmental Conditions for Human Occupancy
ASHRAE 62.1 and 62.2	Ventilation for Acceptable Indoor Air Quality.
AS 1324.1-2001	Air filters for use in general ventilation and air conditioning - Application, performance and construction
AS 1668.4 - 2012	The use of ventilation and air conditioning in buildings – Natural ventilation of buildings
AS 1530	Fire test to building material
AS 1682.1-2015	Fire dampers – Specification
AS 1682.2-2015	Fire dampers – Installation
AS 2913-2000	Evaporative air-conditioning equipment
AS 3823.1.2 - 2012	Performance of electrical appliances – Air conditioners and heat pumps – non-ducted air conditioners and heat pumps - Testing and rating of performance (ISO 5151:2010, MOD)
AS 3959-2018	Construction of buildings in bushfire-prone areas
AS 4072 Part 1- 2005	Components for the protection of openings in fire-resistant separating elements – service penetrations and control joints
	South Australia Environment Protection (Noise) Policy 2007
CIBSE Design guide AM10	Natural ventilation in non-domestic buildings

1.3.2 SA Water Documents

The following table identifies the SA Water standards and other similar documents referenced in this document:

Number	Title
TS 0101	Safety in Design
TS 0300	Supply and Installation of Low Voltage Equipment
TS 0350	SCADA Systems
TS 0601	Design, Assessment and Retrofitting of SA Water Assets in Bushfire-Prone Areas

1.4 Definitions

The following definitions are applicable to this document:

Term	Description
Constructor	The organisation responsible for constructing and installing infrastructure for SA Water whether it be a third party under contract to SA Water or an in-house entity.
Designer	The organisation responsible for designing infrastructure for SA Water whether it be a third party under contract to SA Water or a Constructor, or an in-house entity
SA Water's Representative	The SA Water representative with delegated authority under a Contract or engagement, including (as applicable): • Superintendent's Representative (e.g. AS 4300 and AS 2124, etc.) • SA Water Project Manager • SA Water nominated contact person
Responsible Discipline Lead	The engineering discipline expert responsible for TS 0245 defined on page 3 (via SA Water's Representative)
TDRF	Technical Dispensation Request Form. This form is part of SA Water's Technical Dispensation Request Procedure which details the process by which those required to comply, or ensure compliance, with SA Water's technical requirements may seek dispensation from those requirements.

2 Scope

This technical standard is for the design of ventilation systems for the following SA Water assets:

- Water pumping stations and associated switch rooms
- Wastewater dry well pumping stations and associated switch rooms
- Valve stations and associated switch rooms
- Water and Wastewater chemical dosing stations (solid and liquid dosing only)
- Fan stations

The following assets are excluded from the scope of the technical standard:

- Any design relating to heating
- Gaseous Chlorine buildings/facilities
- Generator facilities
- Office blocks and administration buildings
- Tank ventilation

This standard is intended as a guide to the provision of ventilation systems to maintain operating temperatures for sensitive equipment (mainly electrical/electronic) within the assets. The assets are not normally occupied facilities, and the ventilation requirements are for equipment operation only.

Hazardous area ventilation is not covered in the standard.

3 Design Conditions

Outdoor design conditions

Outdoor designs conditions shall be based on AIRAH Application Manual DA9 Air Conditioning Load Estimation and Psychrometrics (AIRAH DA9). For sites that are not provided in the design guide the following methodology shall be used to determine the outdoor design condition

The air conditioning plant shall continue to operate at the Extreme Ambient Condition without interruption, unloading or shutting down.

The air conditioning plant shall provide the specified performance at the Outside Design Conditions.

Outdoor design conditions – non-critical installations

Summer outdoor design conditions shall be calculated by taking the mean of the 3.00 p.m. dry-bulb and wet-bulb temperatures which are individually exceeded on 10 days per year and adding a standard deviation to the mean to allow for inter annual variability.

Outdoor design conditions - critical installations

Design temperatures based on the mean of the 3.00 p.m. dry-bulb and wet-bulb temperatures which are individually exceeded on an average of one day in two years

Indoor design conditions

Refer to SA water Standard TS 0300 Supply and Installation of Low Voltage Equipment for operating conditions of the electrical equipment. Unless otherwise specified, the following shall be used.

For areas without sensitive electrical equipment, the ventilation system shall be designed to maintain operating conditions of a non-occupied space within -5°C to 60°C.

For areas with sensitive electrical equipment, the ventilation system shall be designed to maintain operating conditions of a non-occupied space within 0°C to 40°C.

The section on Natural Ventilation (6) states that a naturally ventilated room must be designed to have a not greater than 10°C temperature rise above ambient conditions. This indoor design condition for a Naturally Ventilated room shall be designed to achieve the lower of the maximum 10°C above ambient or general operating conditions of 60°C or 40°C, stated above.

All above specified indoor design conditions are for essentially unoccupied spaces. For spaces permanently or temporarily occupied, the system shall be capable of maintaining 22°C +/- 2°C.

Temporarily occupied spaces shall have an 'occupied' room set point, activated by an 'occupancy' button that will direct the control system to operate the space at the lower 'occupied' temperature for a period of 60 minutes (adjustable).

Mechanically Ventilated room shall be designed to achieve the lower of the maximum 10 degrees above ambient or general operating conditions of 60°C or 40°C, stated above.

For refrigerated systems (either air cooled or ground loop), the systems shall be designed to achieve 22°C (when occupied) but would normally be set at 31◦C (unoccupied).

4 Building Classification

This Technical Standard only applies to facilities classified as a 10a – Non habitable building under the National Construction Code (NCC)/Building Code of Australia (BCA).

4.1.1 Criticality

The Designer shall confirm with the SA Water Representative (in writing):

- The criticality of the facility (in accordance with TS 0601) and
- Whether the facility is required to operate during a bushfire event, or to survive such an event and be able to operate immediately after.

Critical facilities (i.e., have a criticality rating of '4' or above per TS 0601) are where the building:

- Is essential to emergency management or post disaster recovery, or
- Operates in the event of a bushfire emergency.

4.1.2 Bushfire-Prone Areas

Facilities located in designated bushfire-prone areas shall meet the requirements of BCA Ancillary Provisions Part G5 Construction in bushfire prone areas.

Facilities must comply with AS 3959 and TS0601.

4.1.3 Building Construction

It is assumed that the facilities will be in accordance with TS 0601.

4.1.4 Building Code of Australia Section J

The intent of BCA Section J is to facilitate the efficient use of energy for Class 2-9 buildings that are conditioned. Thus, whilst Section J is not applicable to a 10a facility, the intent of section J shall be adopted.

Of particular relevance are:

- J1 Building Fabric
- J3 Building Sealing
- J5 Air Conditioning and Ventilation systems

Refer also to section 13 of this Technical Standard.

4.1.5 Building Ventilation Openings

All ventilation openings shall be fitted with weatherproof louvres and bird mesh as a minimum.

Facilities that are classified as 'critical' shall have all building penetrations fitted with fire dampers. Fire dampers shall comply with AS 1530. The rating of the fire dampers are to match the rating of the walls, dependent upon the NCC requirements.

Dampers shall be motorised to enable remote operation, and close upon loss of power.

5 Sequence of Operation

The type of system to be provided and the sequence of operation shall be determined based upon the criticality of the operation of the plant (as described in Section 4.1.1) and the ambient design temperature of the location (as described in Section 3).

The flow chart shown in Figure 1 shall be used to determine the system(s) to be included for a particular installation.

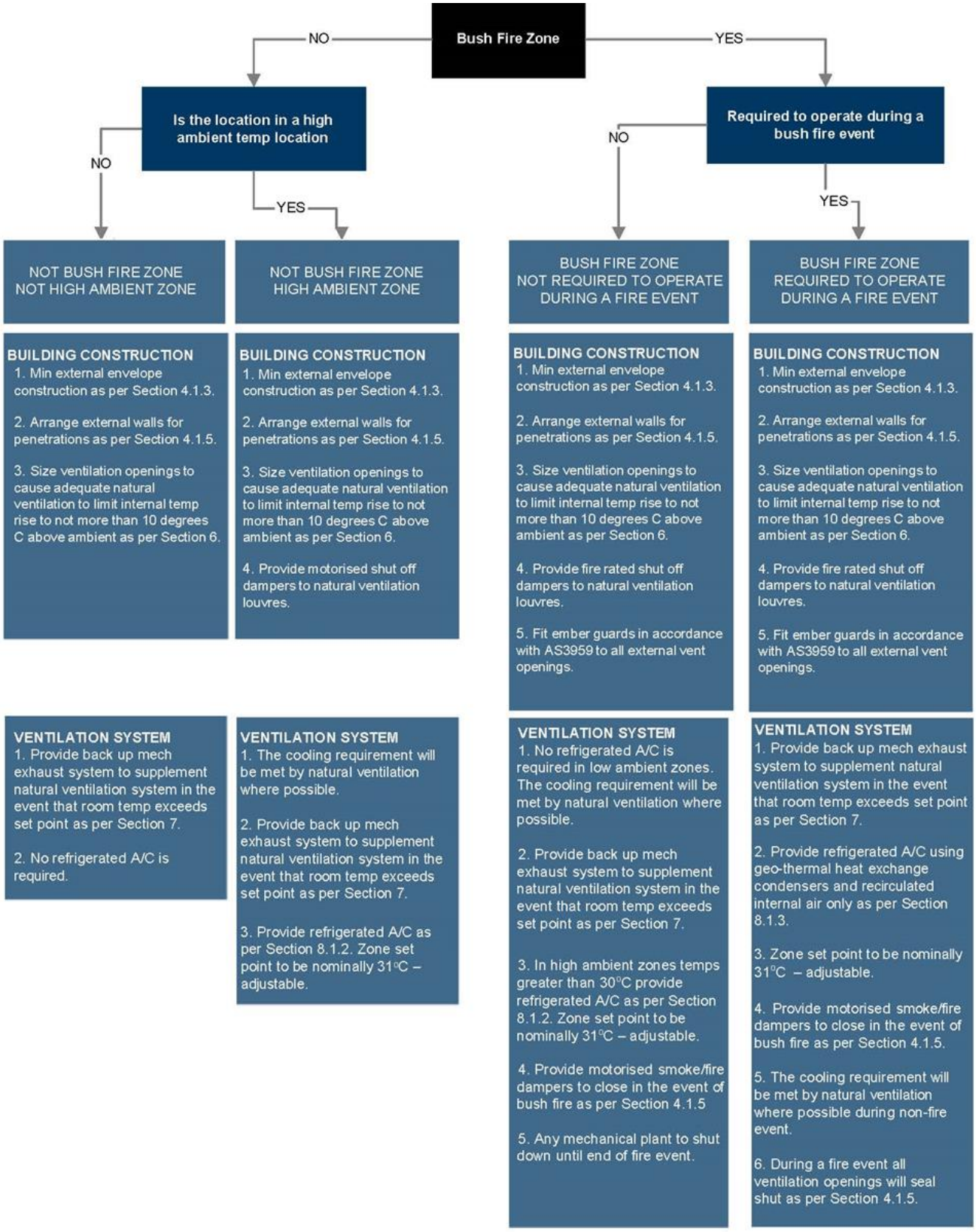
The provision of a refrigerated air conditioning installation will not preclude either a naturally ventilated nor mechanically ventilated solution being applied at times when the ambient conditions permit, to minimise energy consumption during clement weather.

The use of geothermal air conditioning systems are only to be explored if the site is required to remain operational during a bushfire event.

Effectively, the sequence of operation will be similar to an economy cycle. If the space will maintain conditions without either fans or air conditioner running, then it will operate in Natural Ventilation mode. When conditions can no longer be controlled, then the next stage will be allowed to operate.

The use of refrigerant systems with external condensing units or equipment shall not be considered for sites required to operate during a bushfire event.

Figure 1 - Design Flow Chart



Note: In the above flow chart, a "high ambient zone" is considered one where the ambient design condition is greater than 35°C.

6 Natural Ventilation

Natural ventilation can be used to provide ventilation to facilities where there is no temperature sensitive equipment, and the location has low ambient conditions[1].

Natural ventilation should be considered in high ambient locations to supplement or replace other ventilation methods during periods of low ambient conditions, such as during winter or overnight, when internal conditions can be maintained without the use of refrigeration.

The use of natural ventilation is attractive due to its low energy consumption, but careful consideration shall be given by the Designer to any potentially harmful effects of unsuitable ambient conditions, such as high saline or H_2S environments.

AS 1668.4 *The use of ventilation and air conditioning in buildings – Natural ventilation of buildings* is intended for occupied spaces, however, the design principles shall still be adopted for these facilities:

- Low level intake louvres, preferably evenly spread on two different elevations.
- High level relief louvre (or roof cowls).

Calculations of openings are required to be based on the higher of:

- Free area of openings to be not less than 5% of the floor area; or
- Free area of openings to be not less than that required for a 10°C temperature rise in the room (from equipment and solar heat gains) and a maximum pressure drop of 30 Pa. Typically, a face velocity of 1.25 m/s though a weatherproof louvre will result in 30 Pa pressure drop.

Appropriate filters shall be installed to all outside air louvres and must be considered in the calculation of air flow rates and pressure drop.

In bushfire affected zones, ember-proof mesh shall also be installed to outside air louvres, and the pressure drop of these shall be calculated in accordance with the AIRAH design guide.

Design of a natural ventilation system to maintain internal design conditions shall be carried out in accordance with either:

- CIBSE Design guide AM10 – Natural ventilation in non-domestic buildings;
- ASHRAE 55 – Thermal Environmental Conditions for Human Occupancy; or
- ASHRAE 62.1 and 62.2 – Ventilation for Acceptable Indoor Air Quality.

[1] Low Ambient Conditions are considered to be where the design ambient is less than 35°C.

7 Mechanical Ventilation

Mechanical ventilation shall be sized to maintain the room temperature at less than the maximum indoor operating design temperature of the equipment, accounting for both solar and equipment heat loads.

Design is to be based on low-level intake louvres and high-level exhaust fans. It is preferrable to have the intake and exhaust to be on opposite walls and the air flow over the main internal heat source.

For critical installations, the system shall consist of a minimum of two fans under a duty/standby arrangement.

Fans shall start and stop from a temperature sensor in the room.

During natural ventilation mode, the site will be under a negative pressure, but during mechanical ventilation, the site shall be maintained under a positive pressure to minimise infiltration.

8 Air Conditioning

8.1.1 Critical Site Air Conditioning Redundancy

Any site declared by SA Water to be 'critical' shall be designed for 'n+1' for all ventilation and cooling systems.

8.1.2 Refrigerated Air Conditioning

Air conditioning units shall be sized for the full solar and internal equipment loads. For non-bushfire prone areas, the air conditioners shall be air-cooled 'split' units.

The Constructor must comply with Section 4.30 of TS 0300 "Supply and Installation of Low Voltage Equipment"

The condensing unit shall be externally mounted, either on a wall or on a concrete plinth and be protected from vandalism with a cage.

The air conditioning units shall comply with BCA Section J and MEPS ratings.

Room temperature setpoint shall be 31°C for a non-occupied space *(or whatever the maximum recommended operating condition is, as stated by the selected air conditioning equipment manufacturer.)*.

Room setpoints for an occasionally occupied space shall be temporarily set to 22°C +/- 2°C controlled by an 'Occupancy' push button that will reset the setpoint for a period (adjustable) of 60 minutes back to the original default value of 31°C.

8.1.3 Ground-loop/Ground Water Air Conditioning

Ground loop or ground water air conditioning systems are to be considered for critical installations in bushfire-prone areas. Sites located in bushfire-prone areas declared to be required to continue operating during or immediately after a bushfire event, must not use any externally located equipment.

A ground loop air conditioner is a system that circulates water or refrigerant through a subsurface piping loop as a geothermal heat source or a heat sink.

A ground water air conditioner is a water-to-air air conditioner that uses water pumped from a well, lake or stream as a heat source or a heat sink. This is likely to be suitable for pump stations where water is readily available.

Any water extracted must be properly filtered before use in the heat exchanger and returned by a reinjection bore in a sustainable manner.

As these systems do not have an external condensing unit, and can operate at elevated ambient temperatures, they are ideally suited for operation during bushfires.

8.1.4 Cooling Towers

Cooling towers shall not be provided for these facilities.

9 Filtration

Dry particulate filters shall be provided to intakes of mechanical ventilation systems.

Filters shall comply with AS1324. Filters shall be dry-type (Type 1) and Class A (fully disposable) and of minimum grade G3.

Filters for air-cooled split air conditioning units shall be proprietary filters supplied with the unit.

Filters, air inlets, exhaust points etc. provided in bushfire zones shall be provided in accordance with TS 0601.

10 Electrical

Mechanical ventilation and air conditioning systems shall be connected to the facility mains electrical supply.

The requirement for diesel generator backup may be required in sites that are required to operate during a bushfire event. In these circumstances the Designer shall obtain confirmation from the SA Water Representative.

11 Noise Criteria

The operation of a ventilation plant has the potential to generate noise emissions to the surrounding environment.

Noise emitted to the outside from any plant or equipment shall be designed to comply with the South Australia Environment Protection (Noise) Policy 2007 at any nearby noise sensitive receivers. This is particularly important if the nearest identified sensitive receivers are located in a residential zone.

Background noise monitoring should be undertaken, The Noise Environment Protection Policy (EPP). Part 5 requires that for application authorisation, the predicted noise source level (continuous) at the receiver should not exceed the indicative noise level, less 5 dBA.

The Designer shall include attenuation measures in the building and ventilation design to ensure these requirements are satisfied. Acoustic louvres or silencers may be required to ventilation openings.

12 Remote Control and Monitoring

Critical installations shall be monitored from SA Water Operations Control Centre. Switchboard/control panel temperature monitoring is stipulated in TS 0300. SCADA requirements are as per TS 0350.

The following control and monitoring points associated with the ventilation system shall be provided as a minimum:

- Ambient (outside) temperature (value/out-of-range or FAULT);
- Room temperature (for each room) (value/out-of-range or FAULT);
- Ventilation fan status (OFF/ON/FAULT);
- Air conditioning unit status (OFF/ON/FAULT);
- Fire Alarm (if installed); and
- Fire/smoke damper motorised actuation capability (OPEN/CLOSE).

13 Environmentally Sensitive Design and Whole-of-Life

The SA Water publication "Our Strategy 2020-25" declares a strategic focus for Proactive Environmental Leadership; measured in terms of waste reduced, increased by-product reuse, and climate change resilience.

Designers are to be mindful of the consequences upon each of the above metrics. Examples of issues to be considered include:

Waste Reduction

Prefabrication of pipe and duct systems. Avoid the amount of construction waste going to landfill.

By-product Reuse

Substitution of furnace slag, amorphous silica, or fly ash for cement in any concrete work.

Climate Change Resilience

Thermal envelope selection to consider heat build-up due to long-term exposure to higher-than-normal ambient conditions.

Consideration of orientation of assets and external shading to north and west facades.

Consideration of external planting and landscaping to minimise any heat island effects.

13.1 Whole of Life (WOL) Assessment

If there is a choice between two or more systems, and one system performs better in terms of waste reduction, by-product reuse, or climate change resilience; without a cost or program impact, then that system shall be selected.

If there is thought to be a cost premium that a better performing system may incur, then a simple cost/benefit assessment shall be made and provided to the SA Water Representative for direction upon which option to adopt.

14 Safety in Design

All projects at SA Water shall comply with the requirements of TS 0101.

Safe design is the integration of control measures early in the design process to eliminate or, if this is not reasonably practicable, minimise risks to health and safety throughout the life of the structure being designed.

Safe design is a whole of asset life process and begins at the concept development phase of a structure when making decisions about:

- The design and its intended purpose
- Materials to be used
- Possible methods of construction, maintenance, operation, demolition or dismantling and disposal
- What legislation, codes of practice and standards need to be considered and complied with.

15 Redundancy Requirements

The requirement for redundant systems shall be confirmed by SA Water. This is dependent on the criticality of the asset and the sensitivity of the equipment to temperature. Electrical equipment generally has lower operating temperature specifications but can withstand elevated temperatures for short periods.