SAA/SNZ HB32:1995

Handbook

Control of microbial growth in air-handling and water systems in buildings

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Control of microbial growth in air-handling and water systems of buildings

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PREFACE

This Joint Handbook has been prepared by Standards Australia and Standards New Zealand to supersede SAA HB32—1992.

In March 1989, Standards Australia introduced AS 3666—1989, *Air-handling and water systems of buildings—Microbial control*. In 1995 it was revised as a joint Standards Australia/Standards New Zealand publication and was published in two parts.

Although a number of excellent codes of practice, guidelines and technical memoranda now exist, Standards Australia and Standards New Zealand received many requests for assistance with good practice, effective management principles and general explanatory information regarding the Standard. This Handbook is a result of that demand, and further underlines the deep concern in the community about the health hazards presented by *Legionella* and other microbial organisms. In addressing these issues, it is hoped this Handbook will play a useful part in ensuring that equipment hygiene is improved and that the community at large has the best available protection against the likelihood of illness from air-handling and water systems in buildings. This Handbook was first published in 1992 and has been revised to reflect changes to AS/NZS 3666.1:1995 and AS/NZS 3666.2:1995.

Although the Standard is concerned with contamination from general microbial sources, it is the bacterial genus *Legionella* that is primarily of interest because this group of microorganisms is the causative agent for legionellosis, a serious building related illness that can be fatal.

It was, in fact, the death in August 1985 of a Brisbane woman from the disease that led to the development of the Standard. The death was thought to have been linked to an industrial cooling tower system and the Federal Member of Parliament in whose electorate the deceased woman had resided, subsequently wrote to Standards Australia requesting that an appropriate Standard be devised and introduced to establish guidelines for State and Territories governments to follow.

Standards Australia formed a committee comprising experts in engineering, medicine, epidemiology, microbiology, local government and public health as well as building owners. Such modern public health issues are often interdisciplinary in nature.

In 1987 a draft document was produced for public comment. This review period corresponded with Australia's worst outbreak of Legionnaires' disease which occurred at Wollongong in April of that year and so public interest in the proposed Standard was particularly high.

The Standard has indeed now been incorporated in legislation in a number of Australian states and the territories and is referenced in the Building Code of Australia.

The ready acceptance of the Standard arose from a heightened awareness of the hazard to health presented by *Legionella*, a community expectation that the occurrence of epidemics is unacceptable, and a knowledge that the means—as described in the Handbook—are at hand to greatly reduce the risk of such outbreaks.

To control *Legionella* and other microorganisms it is essential to maintain air-handling and water equipment in a hygienic condition so that as far as possible no opportunity is presented for microbial growth to take place.

The emphasis in the Standard is on preventative strategies such as planning, design, installation and operational maintenance of equipment with equipment hygiene in mind, rather than on reactive approaches such as implementation of emergency decontamination measures following an outbreak.

While much of the material is therefore of an engineering nature, it is important to recognize that the best engineering solutions can fail if management is not committed to correct procedures for the control of equipment having public health implications. Unclear definitions of duties and poor reporting procedures are two examples of ineffective management practices that have led to outbreaks of legionellosis.

ACKNOWLEDGMENTS

This Handbook originated from lecture notes presented at seminars sponsored by Standards Australia, and from workshops arranged by The Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH). AIRAH has kindly agreed to the material being incorporated into this Handbook. Special acknowledgment is due to New South Wales State Projects and the Federal Department of Administrative Services for permitting technical material prepared for the seminars and workshops by their officers to be published. Much of the microbiological information presented in the Introduction was prepared by Aquatech Pty Ltd and presented at a Building Owners and Managers Association (BOMA) seminar and permission to use this material is appreciated.

Thanks are due also to Temperature Engineering Pty Ltd for providing several of the photographs of cooling towers, and to Butterworth Heinemann, publishers of the book, *Legionella and Building Services*, by G.W. Brundrett (1992), for permission to reproduce the diagrams illustrating the different types of cooling towers.

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INTRODUCTION

Microorganisms (microbes) are present in almost every environment found on the surface of the earth. They are largely present in soil, water, food, and air. In buildings, microorganisms are generally found on surfaces (such as carpet, ceiling, tiles) or floating on dust/aerosol particles.

AS/NZS 3666 series is concerned primarily with the microbiological aspects of the indoor environment. There are six main microbiological groups which consist of the following in order of complexity (as well as increasing size):

Group	Average size (diameter) μm
Viruses	0.03–0.8
Bacteria	0.5–2
Actinomycetes	0.5–2
Fungi	5–15
Algae	5–15
Protozoa	5–100

Of these groups, the ones generally found in indoor environments are:

- viruses
- bacteria *(e.g. Pseudomonas, Staphylococcus)*
- actinomycetes *(e.g. Mycobacterium)*
- fungi *(e.g. Penicillium, Aspergillus, Cladosporium, Candida)*

Microorganisms require water and nutrients in order to survive. Water can be in the form of free water or humidity while nutrients can be items such as carpet fluff or dust, food residue, skin and hair fragments. Although microorganisms can survive and multiply on most surfaces, they cannot multiply in air, and will gradually die in that medium. They can be carried into a building by a variety of means during construction, as well as during subsequent use.

Microorganisms are enumerated in the laboratory using microscopy or microbiological media. Results are expressed in terms of colony forming units or cfu. One cfu can be a clump of 1–1000 individual cells, although in air it is usually 1–10 individual cells. Average indoor air concentrations of bacteria are about 100 cfu/m^3, whereas the corresponding figure for fungi is about 200 cfu/m^3.

The best control measures attempt to remove the food/nutrients available to microorganisms (as well as the microorganisms themselves), within the indoor environment. This can be achieved by regular cleaning of carpets, floors and surfaces, as well as by reducing the entry of dust/mud/decaying matter (e.g. rotting fruit).

Because microbes can gain entry to the building via the air-handling systems (which draw in air from outdoors for ventilation purposes) appropriate control measures need to be applied to such systems. Modern buildings are also served by a number of water systems, e.g. hot water services for ablutions and cooling towers for heat removal. Appropriate control measures are essential for these systems because, being water based, they clearly provide an opportunity for microbial growth to occur if not kept under control.

This Handbook provides guidance for microbial control for both air-handling and water systems in buildings to support the specific requirements of AS/NZS 3666 series.

1 AIR-HANDLING SYSTEMS IN BUILDINGS

1.1 General Air-handling systems are designed for the environmental needs of occupants and to satisfy statutory regulations.

Active and passive strategies to control and eliminate microbial contamination of air-handling systems can be incorporated into the conceptual design phase and implemented in the design development and construction stages of building projects.

As an example of the need to design for maintenance, air-handling equipment is sometimes located in places that are difficult to access. Such locations include places requiring ladders for access, have heavy or inconvenient access doors to unbolt or are located without any access provided, e.g. on the roof. It follows that such equipment will suffer from poor maintenance. Quick release doors and doors that are hinged for maintenance access need to be designed into systems in order to facilitate ongoing maintenance.

1.2 Air intakes and exhaust air outlets Outdoor air is required to be introduced into buildings for ventilation purposes. In most cases the air-handling plant incorporates the outdoor air intake on the return side of the plant so it can be filtered and conditioned (heated or cooled) before distribution to occupied spaces.

Outdoor contaminants including microorganisms may enter a building with the outdoor air. Sometimes wall-mounted air intakes are inadvertently located near sources of pollution, e.g. intakes in close proximity to—

(a) cooling towers (bacteria and trace chemicals);

(b) car park vehicle exhaust points (carbon monoxide);

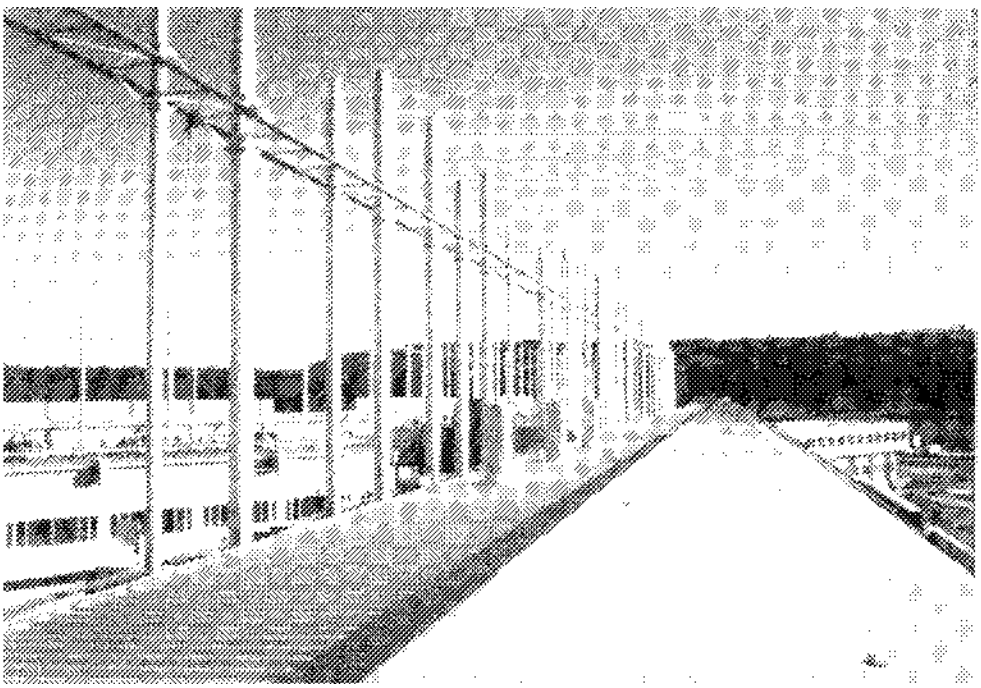
(c) pigeon roosts (fungal spores);

(d) boiler emissions (airborne hydrocarbons or exhaust gases);

(e) odours from garbage containers (decaying organic matter);

(f) toilet exhausts (foul odours); and

(g) kitchen exhausts (decaying organic matter, fumes).



An arrangement of exhaust ducts ensuring a good separation distance between the exhaust emission and the air intakes to the building.

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