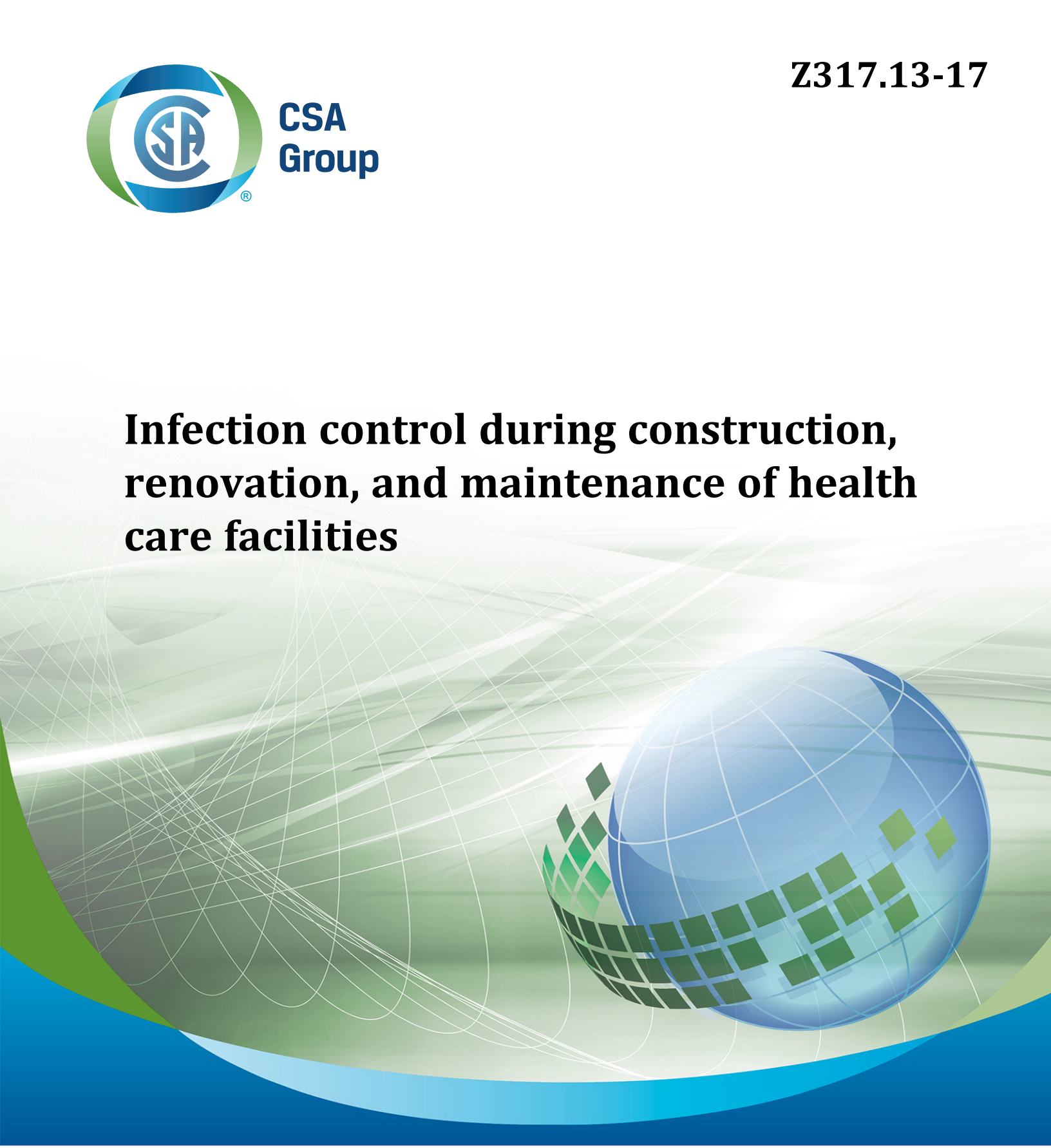
CSA Group

Z317.13-17

Infection control during construction, renovation, and maintenance of health care facilities



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Preface

This is the fourth edition of CSA Z317.13, *Infection control during construction, renovation, and maintenance of health care facilities*. It supersedes the previous editions, published in 2012, 2007, and 2003. It is part of a series of Standards related to health care facility engineering and sets forth preventive measures intended to protect patients, staff, and visitors from disease transmission and other health problems, such as allergic reactions, that can be produced by the construction, renovation, or maintenance of health care facilities.

The first edition of this Standard was based on *Construction-related Nosocomial Infections in Patients in Health Care Facilities: Decreasing the Risk of* Aspergillus, Legionella *and Other Infections*, published by Health Canada in 2001.

Changes to this edition include the following:

a) new and revised requirements for cleaning of construction sites and building components, both during and after construction;
b) expanded new requirements for wall materials and design in areas subject to moisture;
c) updated requirements for monitors and alarms to maintain relative pressurization at construction sites;
d) reorganization of the existing annexes, and creation of new informative annexes to provide sample checklists and additional guidance;
e) revised clauses on the use of the building's HVAC system for air supply to construction areas;
f) revised requirements for cleaning and testing of construction air handling units (CAHUs) between uses;
g) new requirements to prevent contamination of water systems during construction activities;
h) additional requirements around orientation and training of personnel working on construction sites;
i) additional information on roles and responsibilities of infection prevention and control personnel and the MDT; and
j) new and revised requirements for post-construction evaluation and documentation.

CSA Group acknowledges that the development of this Standard was made possible, in part, by the financial support of the governments of Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Northwest Territories, Nova Scotia, Nunavut, Ontario, Prince Edward Island, Québec, Saskatchewan, and Yukon, as administered by the Canadian Association for Drugs and Technology in Health (CADTH).

This Standard was prepared by the Subcommittee on Infection Control During Construction/Renovation of Health Care Facilities, under the jurisdiction of the Technical Committee on Health Care Facilities and the Strategic Steering Committee on Health Care Technology and Systems, and has been formally approved by the Technical Committee.

Notes:

1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*

2) *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*

3) *This Standard was developed by consensus, which is defined by* CSA Policy governing standardization — Code of good practice for standardization *as "substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity". It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this Standard.*

4) *To submit a request for interpretation of this Standard, please send the following information to inquiries@csagroup.org and include "Request for interpretation" in the subject line:*

a) *define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;*
b) *provide an explanation of circumstances surrounding the actual field condition; and*
c) *where possible, phrase the request in such a way that a specific "yes" or "no" answer will address the issue.*

Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization *and are available on the* Current Standards Activities *page at* ***standardsactivities.csa.ca****.*

5) *This Standard is subject to review within five years from the date of publication. Suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include "Proposal for change" in the subject line:*

a) *Standard designation (number);*
b) *relevant clause, table, and/or figure number;*
c) *wording of the proposed change; and*
d) *rationale for the change.*

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Infection control during construction, renovation, and maintenance of health care facilities

0 Introduction

0.1
This Standard was developed in response to evidence of the serious health risks for patients, staff, and visitors from construction, renovation, and maintenance activities. Without the proper precautions, these activities can disperse dust particles contaminated with bacteria and fungi. The evidence led to the conclusion that early planning in construction and renovation projects must integrate infection prevention and control, engineering services, and facility design to prevent infections and minimize allergen load and other workplace hazards.

Precautionary measures during construction-related activities reduce the risk of infection (see Health Canada's *Construction-related Nosocomial Infections in Patients in Health Care Facilities: Decreasing the Risk of* Aspergillus, Legionella *and Other Infections*). In order to establish precautionary measures, health care facility personnel need to consider the type of construction, renovation, or maintenance work being undertaken and the proximity of such work to the occupants.

0.2
Construction-related infections caused by *Aspergillus, Legionella*, and other agents have led to serious infections and even deaths in health care facilities. Aspergillosis is acquired primarily by inhalation of fungal spores, which can lead to pneumonia following local lung tissue invasion. The fungus can also disseminate through the bloodstream to involve deep organs. Aspergillosis is difficult to diagnose and treat; consequently, there should be an emphasis on prevention and improved detection. The mortality rate for aspergillosis acquired in health care facilities (i.e., an *Aspergillus* infection) is between 65 and 100%, and the mortality rate for legionnaires' disease (pneumonia caused by *Legionella*) is between 24 and 80%, even when these infections are recognized and treated.

0.3
Immunosuppressed patients, the elderly, and the very young are at greatest risk of acquiring a fungal or bacterial infection. The immunosuppressed group includes patients who have undergone bone marrow or solid organ transplants, patients receiving dialysis, patients taking immunosuppressive medications (including steroids), and oncology patients receiving chemotherapy. Appropriate mitigation measures focusing on patient safety are necessary before and throughout construction, renovation, and maintenance.

0.4
Assessing the risks to health care facility occupants and preventing and detecting fungal and bacterial infections requires a multidisciplinary team approach to

a) improve understanding of the issues;

b) identify responsibilities;
c) implement suitable avenues of communication between responsible parties; and
d) plan and implement measures to mitigate risks.

0.5

An effective program of infection prevention and control will also work towards continual improvement by documenting the mitigation measures applied and any incidents that occur, and applying the lessons learned to future projects.

1 Scope

1.1

This Standard specifies precautionary and remedial measures, including quality system requirements, for preventing exposure to agents released or augmented because of actions undertaken during health care facility construction, renovation, maintenance, and repair work.

1.2

This Standard is intended to apply to the activities of the following individuals or groups in relation to any aspect of construction, renovation, maintenance, or repair of health care facilities:
a) commissioning teams;
b) constructors;
c) infection prevention and control personnel;
d) architects, engineers, and other design and construction consultants;
e) planning and project managers;
f) facility managers and maintenance managers;
g) environmental services staff;
h) health care staff;
i) occupational health and safety professionals; and
j) operation and maintenance staff.

1.3

This Standard applies to all types of health care facility construction projects, no matter what construction delivery method is used (e.g., stipulated sum, public-private partnership).

1.4

This Standard has been developed for use during the project specification phase of construction, renovation, and maintenance and repair projects, and to assist in preventing and controlling fungal and bacterial infections during the implementation of such projects.

1.5

In this Standard, “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the Standard; “should” is used to express a recommendation or that which is advised but not required; and “may” is used to express an option or that which is permissible within the limits of the Standard.

Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material.

Notes to tables and figures are considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

2 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below, including all amendments published thereto.

Note: *Additional reference material is provided in Annex J.*

CSA Group

Z317.1-16
Special requirements for plumbing installations in health care facilities

Z317.2-15
Special requirements for heating, ventilation, and air conditioning (HVAC) systems in health care facilities

Z8000-11 (R2016)
Canadian health care facilities

CAN/CSA-Z8001-13
Commissioning of health care facilities

ASHRAE (American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers)

ANSI/ASHRAE 55-2010
Thermal Environmental Conditions for Human Occupancy

CCA (Canadian Construction Association)

82-2004
Mould Guidelines for the Canadian Construction Industry

EACO (Environmental Abatement Council of Ontario)

DOP/PAO Testing Guideline, 2013

Health Canada

Construction-related Nosocomial Infections in Patients in Health Care Facilities: Decreasing the Risk of Aspergillus, Legionella *and Other Infections.* Canada Communicable Disease Report Supplement, Volume 27S2, July 2001

Note: *This report is archived on the Health Canada web site at*
http://publications.gc.ca/collections/collection_2016/aspc-phac/HP3-1-27-S2-eng.pdf

IEST (Institute of Environmental Sciences and Technology)

RP-CC001.4 (2005)
Hepa and Ulpa Filters

RP-CC021.3 (2010)
Testing HEPA and ULPA Filter Media

RP-CC034.3 (2009)
HEPA and ULPA Filter Leak Tests

IICRC (Institute of Inspection, Cleaning and Restoration Certification)
ANSI/IICRC R520-2015
Reference Guide for Professional Mold Remediation

ANSI/IICRC S500 (2015)
Standard and Reference Guide for Professional Water Damage Restoration, 4th edition

ANSI/IICRC S520 (2015)
Standard for Professional Mold Remediation, 3rd edition

ISO (International Organization for Standardization)
14644-2:2000
Cleanrooms and associated controlled environments — Part 2: Specifications for testing and monitoring to prove continued compliance with ISO 14644-1

NADCA (National Air Duct Cleaners Association)
NADCA General Specifications for the Cleaning and Restoration of Commercial Heating, Ventilating and Air Conditioning Systems, 2015

New York City Department of Health and Mental Hygiene, Bureau of Environmental and Occupational Disease Epidemiology
Guidelines on Assessment and Remediation of Fungi in Indoor Environments, 2008

NSF International
NSF/ANSI 49-2008
Biosafety Cabinetry: Design, Construction, Performance, and Field Certification

PIDAC (Provincial Infectious Diseases Advisory Committee, Province of Ontario)
Best Practices for Environmental Cleaning for Prevention and Control of Infections — 2nd edition, May 2012

SMACNA (Sheet Metal and Air Conditioning Contractors' National Association)
Duct Cleanliness for New Construction Guidelines, 2000

U.S. Department of Defense
MIL-STD-282 (1995)
Filter Units, Protective Clothing, Gas-Mask Components and Related Products: Performance Test Methods

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention
Guidelines for Environmental Infection Control in Health-Care Facilities, 2003

Other publications

Cheng, S.M. and Streifel, A.J. 2001. "Infection control considerations during construction activities, land excavation and demolition", *American Journal of Infection Control*, October 5(29): 321–328

3 Definitions and abbreviations

3.1 Definitions

The following definitions shall apply in this Standard:

Adjacent areas — all of the areas surrounding an area where construction, renovation, or maintenance work is occurring, including, where applicable, all or part of the floors above and below.

Note: *Determining what constitutes an adjacent area depends on the risks created by the work. For example, where Type A construction work (which does not generate dust) is being performed (see Table 3), it is possible that only the rooms whose walls, floors, and roofs adjoin the area where the work is being performed will be considered adjacent areas. Conversely, where Type D construction work involving major demolition or road repair outside the health care facility is being performed (see Table 3), it is possible that the entire facility will be considered an adjacent area.*

Anteroom — a small room that is immediately adjacent to or within a construction area and is intended to be used by constructors for purposes such as storage or removal of protective clothing, cleaning of debris-removal containers, and/or removal of contaminants from footwear.

Aspergillosis — an *Aspergillus* infection.

Aspergillus — a genus of fungi found in soil, water, decaying vegetation, and damp materials. The fungal spores (conidia) proliferate on dead organic debris and can remain viable for months in dry locations.

Commissioning (commissioning process) — a systematic verification, documentation, and training process applied to all activities during the design, construction, static verification, start-up, and functional performance testing of equipment and systems in a facility to ensure that the facility operates in conformity with the owner's project requirements and the basis of design in accordance with the contract documents.

Note: *Commissioning is an integral part of the design and construction process, and is intended to be undertaken throughout the life of a facility.*

Construction — major and minor facility activities that disturb or modify facility structures or systems.

Note: *In this Standard, the term includes not only new construction, but also renovation, maintenance, and repairs. See* **New construction***.*

Construction activity type — a designation applied to a construction project to indicate its potential for creating and dispersing fungus, bacteria, and other hazardous materials. See Table 3.

Note: *Construction activity types are as follows:*

a) *Type A — inspection and non-invasive activities.*
b) *Type B — small-scale, short-duration activities that create minimal dust.*
c) *Type C — activities that generate a moderate to high level of dust, require demolition, require removal of a fixed facility component (e.g., sink) or assembly (e.g., countertop or cupboard), or cannot be completed in a single work shift.*
d) *Type D — activities that generate high levels of dust, and major demolition and construction activities that require consecutive work shifts to complete.*

Construction air handling unit (CAHU) — a machine used to move HEPA-filtered air into or out of a construction site.

Note: *CAHUs can be used to develop negative pressure from within the construction space or positive pressure outside of the construction space. They can be outfitted with a variety of filters to "scrub" the surrounding air and remove and capture different types of contaminants such as dust, mould spores, and certain chemical agents or odours.*

Construction clean — an ongoing program of cleaning activities performed during construction to

a) maintain site cleanliness during the project (i.e., through a daily cleanup);
b) prevent dust and debris from being trapped in fixtures, the ceiling, and other closed off spaces; and
c) maintain conditions that will facilitate the effective final cleaning of the site prior to hand-over.

Notes:

1) *See **Final construction clean**.*

2) *Construction clean is not a single event, but a continuous process starting at the commencement of the work and finishing at the hand-over of the site to the HCF. It is achieved through a system of cleaning practices, methods statements, checklists, and quality audits.*

3) *Construction clean is generally applied to area bounded by the project, including access routes.*

Constructor — a person who undertakes construction, renovation, maintenance, or repair work for an owner.

Note: *A constructor can be, for example, a prime (or general) contractor, contractor, subcontractor, construction manager, construction worker, tradesperson, or facility operations and maintenance staff.*

Consultant — a person with specialized skills in health care facility design, construction, project management, or engineering, who is engaged by the owner of a construction project (or the owner's representative) for the purpose of designing, managing, or otherwise contributing their expertise to the project.

Note: *See **Primary consultant** and **Infection prevention and control consultant**.*

Environmental services — health care facility services such as general housekeeping, waste management, pest control, or hazardous material cleanup.

Final construction clean — a state of cleanliness at the end of the project that allows for effective terminal cleaning of the construction site by the HCF after hand-over.

Flash cove — a flooring configuration whereby a baseboard is formed by running the edge of resilient sheet flooring up the wall.

Fungi — a diverse group of organisms that includes yeasts, moulds, and mushrooms. They are found in soil, water, and air and, lacking chlorophyll, derive nourishment from breaking down organic matter.

Note: *Many types of fungi reproduce by means of spores that are readily dispersed in air.*

Health care facility (HCF) — a set of physical infrastructure elements supporting the delivery of health-related services.

Note: *An HCF can comprise a single room or area, an entire building, or a group of buildings. An HCF can also be a non-stationary unit such as a mobile facility, ambulance, or trailer where health care services are provided (although these are outside the scope of this Standard). In addition, different classes of HCF can reside in the same building or structure.*

> **Class A HCF** — an acute care facility where patients are accommodated on the basis of medical need and are provided with continuing medical care and supporting diagnostic and therapeutic services, generally involving an overnight stay.

Class B HCF — a facility whose residents cannot function independently because of a physical or mental disability and are accommodated because they require daily care by health care professionals but generally do not require invasive medical interventions.

Class C HCF — a facility where ambulatory patients are provided with supportive, diagnostic, and treatment services on an outpatient or occasional basis.

Health care staff — medical, nursing, and auxiliary personnel involved in patient care.

HEPA (high-efficiency particulate air) filter — an air filter meeting the requirements for a Type A filter as specified in IEST RP-CC001.4.

Note: *HEPA filters have a minimum efficiency of 99.97% when tested on particles 0.3 µm in size.*

HEPA-filtered vacuum — a vacuum cleaner equipped with HEPA filtration that is capable of being performance leak tested.

Notes:

1) *Characteristics that can affect the results of performance leak testing include*
   a) *filter fit;*
   b) *quality of seals;*
   c) *quality of filtration; and*
   d) *physical damage to filters, seals, or other critical components.*

2) *Contractors may decide to use vacuums labelled "HEPA" for various tasks on the construction site. The purpose of this definition is to highlight the importance of having the vacuum in sound condition and able to pass the necessary tests before it is used for activities covered in this Standard (e.g., as a CAHU).*

3) *It is the MDT's decision regarding at what construction phase the vacuums have to be performance leak tested (e.g., starting at phase 3).*

Immunodeficiency — a decreased or compromised ability to respond to antigenic stimuli (stimuli capable of causing antibody production) with an appropriate cellular immunity reaction.

Immunosuppressive — acting to suppress the body's natural immune response to an antigen (a substance on the surface of a cell that stimulates the production of antibodies).

Infection control plan — collection of means and methods to accomplish the necessary preventive measures as identified through the infection control risk assessment.

Infection control risk assessment (ICRA) — a process used to identify design elements that increase the risk of microbial transmission in the environment.

Notes:

1) *An ICRA considers the facility's patient population and clinical programs, and the potential effects of disruptions to essential services (e.g., water, ventilation, electricity) that could affect patient placement or necessitate relocation of patients.*

2) *For the purposes of this Standard, an ICRA would focus on the potential infection risks posed by construction activities and the movement of people and materials in and around construction sites.*

3) *Annex H provides a sample template for evaluating a project and performing an initial ICRA.*

Infection prevention and control consultant — a professional with demonstrated education and training, knowledge, and experience who advises on and monitors required infection prevention and control strategies, approaches, methods, and measures.

Note: *Professional qualifications could include one or more of the following:*

a) *infection prevention and control professional;*
b) *engineer with experience in health care;*
c) *environmental consultant;*

d) *industrial hygienist; or*
e) *other related professions.*

Legionella — a genus of gram-negative bacteria found in soil, water, and dust.

Legionnaires' disease — a pneumonia that is caused by *Legionella* and is usually acquired by inhalation of contaminated aerosols.

Notes:

1) *Although many species of Legionella can cause this disease, it is most commonly associated with* Legionella pneumophila*.*

2) Legionella *bacteria can also cause "pontiac fever", which is a self-limiting febrile illness that does not progress to pneumonia.*

Maintenance — a type of construction activity conducted to preserve the condition and functionality of a physical element of a health care facility.

Notes:

1) *See* ***Construction****.*

2) *Maintenance can be performed by an equipment supplier, contractor, or facility-based operation and maintenance staff.*

3) *The term "maintenance" also covers repairs.*

Micro-organisms — living organisms of microscopic size.

Note: *The term is generally used herein to refer to bacteria, fungi, viruses, and bacterial spores.*

Mould — a woolly, furry, or staining growth of fungi that can produce microscopic spores capable of causing human infections or allergic reactions if dispersed.

Note: *Construction, renovation, maintenance, and demolition can increase the risk of infections or allergic reactions by dispersing spores.*

Multidisciplinary team (MDT) — a group comprising representatives from various disciplines in the health care facility that works with the project management team and others to ensure that the appropriate infection prevention and control measures are followed during construction activities.

Notes:

1) *MDTs will generally be involved in all phases of health care facility construction, including planning, design, implementation phases, commissioning, occupancy, and maintenance.*

2) *MDTs can vary in size, scope, and time of service depending on the type of health care facility and the level of construction activity. In a larger regional health system, typical types could include the following:*

a) *Project MDT — A project-specific MDT created to ensure compliance with this Standard during development, design, tendering, construction, and commissioning of a project. See Clause 6.2.3.*

b) *Site MDT — A standing team located at sites that have continuous construction. The site MDT provides representatives for project MDTs and also for ongoing maintenance operational activities. See Clause 6.2.2.*

c) *Permanent MDT — A standing MDT, usually serving a health region or consortium, that provides a technical resource and overview for consistent application of this Standard to site MDTs. See Clause 6.2.1.6.*

3) *In a smaller, stand-alone facility, these functions may all be managed under one MDT.*

Negative air machine/negative air unit — see **Construction air handling unit (CAHU)**.

New construction — a project intended to produce a complete health care facility, or a new section of an existing facility, that did not exist prior to the project.

Notes:

1) *New construction includes projects on vacant land (e.g., greenfield, brownfield), additions to existing health care facilities, and significant renovations to existing spaces in order to change their functional purpose.*

2) *A project in which an existing patient care unit in a health care facility is being renovated to be used for a similar purpose is considered to be a renovation (e.g., a medical-surgical in-patient unit being renovated to become an oncology in-patient unit). By contrast, a project including a change of functional purpose is considered to be new construction (e.g., a medical-surgical in-patient unit being renovated to become an outpatient fracture clinic).*

3) *New construction is categorized as follows:*

a) *new location (Category 1);*
b) *existing detached location (Category 2); and*
c) *existing connected location (Category 3).*

4) *Major renovation can also qualify as new construction, depending on the scope of the work.*

5) *See Clause 8 for further information on these categories.*

Occupant — a patient, resident, staff member, or visitor in a health care facility.

Operation and maintenance staff — health care facility employees or contract personnel who are responsible for the day-to-day operation of, and repairs to, the facility infrastructure and systems.

Note: *These personnel are sometimes referred to as facility engineers, engineering department staff, facility operations, engineering, and maintenance staff, etc.*

Owner — the person or organization ultimately responsible for the delivery of health care services in a health care facility.

Note: *The owner is not necessarily the one who holds legal title to a building or property. For example, the owner of a health care facility in a leased building is the physician or group that manages the health care facility.*

Patient — a person undergoing medical investigation, care, or treatment.

Plumbing dead leg — a pipe or other plumbing component or system that has contained, contains, or likely will contain stagnant water.

Preventive measure (PM) — a system involving precautionary actions, equipment, barriers, and inspections at each phase of a project to decrease the spread of contaminants during construction, renovation, or maintenance of a health care facility.

Note: *This Standard defines four levels of preventive measure. The level that is applied to a given project depends on the scope of the project and the potential risks to patients. See Table 1.*

Preventive measures analysis — the process of evaluating construction-related risks to patients and staff and determining the preventive measures that will be necessary to mitigate those risks.

Primary consultant — the person engaged by the owner or the owner's authorized representative for a construction project who oversees and coordinates the entire project.

Note: *For health care facility renovation or new construction projects, there is usually a primary consultant (typically an architect or engineer engaged by the owner or the owner's authorized representative) who oversees and coordinates the project, including the work of structural, mechanical, and electrical engineers. The primary consultant could also be the design-build constructor or construction manager. Additional specialty consultants can be engaged to manage specific elements such as acoustics, environmental, food service, building code, interior design, landscape architecture, etc.*

Pseudo-infection — a false-positive laboratory result produced by contaminated equipment during a test for infection.

Note: *Improper handling of laboratory specimens can produce false positives.*

Quality control — the routine testing of materials, equipment, processes, and products to ensure their specifications are met.

Quality management — coordinated activities to direct and control an organization with regard to quality.

Quality system — the organizational structure, responsibilities, procedures, instructions, processes, and resources involved in the implementation of quality management.

Renovation — see **Construction**.

Surveillance — the systematic observation of the occurrence and distribution of disease processes in a population.

Terminal cleaning — the thorough cleaning of a clinical space by the health care facility following construction and before the space is used for patient care, medical equipment, or the storage of clean or sterile supplies, in order to remove contaminating micro-organisms that could be acquired by subsequent occupants or staff.

Note: *Terminal cleaning is also referred to as hospital cleaning, clinical cleaning, or return to service cleaning. The intent is to bring the space to the point where it can be safely used for patient care.*

Walk-off mat — a specially designed mat that is placed outside a construction area or in an anteroom and is intended for removal of contaminants from the footwear of workers.

Note: *Walk-off mats include, for example,*

a) *mats for removal of sand and winter road salt;*
b) *mats with a sticky surface;*
c) *sections of carpet made with synthetic fibres; or*
d) *antibacterial mats that include a frame allowing for placement of antibacterial solutions.*

Wood moisture equivalent — the moisture content value of a material, typically expressed as a percentage, based on a scale relative to wood.

Note: *Field instruments used to measure moisture content are typically calibrated to a particular species of wood. Calibration woods can vary between manufacturers and instruments and the user should refer to the manufacturer's recommendations prior to use or the application of measurement correction factors.*

3.2 Abbreviations

The following abbreviations shall be used in this Standard.

BAS — building automation systems

CAHU — construction air handling unit

HCF — health care facility

ICP — infection prevention control professional

ICRA — infection control risk assessment

MDT — multidisciplinary team

PM — preventive measure

PPE — personal protective equipment

4 General

4.1 Quality system

4.1.1

The health care facility (HCF) shall have a quality system in place to control, monitor, and continually improve its activities related to infection prevention and control during construction, renovation, and maintenance. The quality system may be part of the overall quality system for the facility or for a department within the facility.

4.1.2

The quality system shall include

a) written policies and procedures that are regularly reviewed and updated, with document controls to ensure that everyone is using the most recent procedures;
b) personnel policies that specify staff training, qualifications, responsibilities, and reporting relationships, and that support continual improvement;
c) process controls to ensure that procedures are being followed; and
d) a process for periodic review and continual improvement.

Notes:

1) *The goal of a quality system is to provide assurance that the facility's policies, processes, and procedures comply with this Standard, and that the facility's services provide the highest possible degree of safety and quality. A well-managed quality system is intended to produce an environment in which qualified staff, working with well-documented procedures under knowledgeable supervision, provides consistent and effective service to the HCF.*

2) *Involvement of appropriate staff in every aspect of operations helps to ensure that the facility will meet its stated quality objectives. System management procedures should indicate how these objectives can be met on the basis of defined quality criteria and suitable control measures.*

3) *Periodic review and continual improvement as addressed in Item d) should be the responsibility of a standing committee (e.g., a multidisciplinary infection prevention and control resource committee that can provide overview and perform continual improvement reviews).*

4.1.3

The quality system shall be documented, either manually or electronically. The document shall include a chart that outlines the organizational structure of the facility and the role of the site MDT. The document shall specify the lines of responsibility and authority. It should include a decision tree diagram that outlines how facility management infection prevention and control decisions are made within the corporate organization and at the site level.

4.1.4

The degree of responsibility associated with each staff position and department with respect to infection prevention and control during construction, renovation, or maintenance shall be formally specified. The quality system documentation shall identify the degree of authority necessary for evaluating quality problems and initiating, recommending, and providing effective corrective action.

4.1.5

Written procedures shall describe each process or service engaged in or provided by the site MDT, staff, and departments, related to their roles in infection prevention and control during construction, renovation, or maintenance.

Note: *The purpose of a written procedure is to ensure the quality of each process or service.*

4.1.6

Procedures shall be reviewed and updated at least annually by the site MDT, and the MDT shall have the authority to make necessary changes to ensure compliance with current or new requirements and/or changes in practice.

In addition, an operating procedure shall be reviewed in response to

a) any accident, error, adverse event (e.g., an infection), or significant incident related to activities governed by the procedure;
b) changes in this Standard and other relevant standards and guidelines, or in applicable laws or regulatory requirements;
c) results obtained from internal or external audits; and
d) other conditions or situations specified in the facility's policies.

Note: *Accidents, errors, and adverse events are occurrences that can adversely affect the safety of patients, facility personnel, or the public. The facility should also monitor trends in the occurrence of less serious accidents or errors; doing so can help in the early identification of problems.*

4.1.7

The quality system shall ensure that any deviations from normal procedures (e.g., errors and incidents) are identified, investigated, and evaluated, and that corrective action is taken when necessary. This process shall be documented.

4.1.8

The HCF administrator shall review the quality system at specified intervals. Internal audits should be performed periodically to verify the continuing effectiveness of the system. These audits shall be carried out in accordance with an established program by trained personnel with well-defined responsibilities and authority who are not directly responsible for the procedures being audited. The findings of the reviews and audits specified in this Clause shall be documented.

Note: *The "HCF administrator" refers to the person ultimately responsible for quality systems within the facility [e.g., the Chief Operating Officer (COO) or Vice-President, Quality and Risk].*

4.1.9

Consideration should be given to periodic audits to measure progress and identify areas for improvement.

Note: *This audit would focus exclusively on the HCF's policies, procedures, and performance with respect to infection prevention and control during construction, renovation, and maintenance and would, therefore, not be associated with the HCF's regular accreditation survey. The audit should be conducted by someone not directly involved in the construction or MDTs. The audit may involve resources external to the organization.*

4.1.10

The HCF administrator shall be able to demonstrate that there is adequate supervision and control of all

functions performed by subcontractors or service providers that could affect the HCF's performance under this quality management system.

Note: *If an organization other than the HCF is the contract holder for a construction project (e.g., a provincial/ territorial infrastructure agency), that organization would need to provide documentation to the HCF sufficient to demonstrate compliance with this Clause.*

4.2 Risk factors related to construction, renovation, and maintenance

4.2.1

Construction, renovation, and maintenance projects in health care facilities pose a potential threat of infection to current and future occupants, particularly those with reduced immunity. Reduced immunity can result from many different illnesses or conditions, including for example,

a) bone marrow or solid organ transplantation;
b) receipt of chemotherapy for cancer or other conditions;
c) use of antibiotics to treat fevers or previous infections;
d) HIV and AIDS;
e) immune system defects present at birth;
f) dialysis or kidney failure;
g) diabetes;
h) chronic lung disease;
i) assisted breathing (i.e., being on a ventilator);
j) heart disease;
k) cancer;
l) surgery and other invasive medical procedures; and
m) extremes of age (e.g., newborns or elderly individuals).

4.2.2

Micro-organisms that cause infection can be transmitted in various ways from sources such as air, water, or contaminated surfaces. The probability that infectious micro-organisms will grow and spread is higher with certain materials, and with the presence of moisture. For patients, staff, and other HCF occupants, environmental risk factors include exposure to

a) construction activities (including renovation, maintenance, and new building excavation);
b) plumbing system interruptions and other malfunctions; and
c) any other activity that disturbs, moves, or promotes the growth of micro-organisms.

4.2.3

Additional risks can be indirect, for example laboratory specimens exposed to construction activities can become contaminated and lead to false-positive laboratory results (pseudo-infections).

4.3 Sources of contamination and construction-related infections in health care facilities

4.3.1

Some of the environmental sources of infection in health care facilities include soil, water, and dust, which can be a source of fungal spores, bacteria, or other micro-organisms.

4.3.2

Contamination can be caused by many factors during construction, including

a) inadequate preparation and quality control;
b) inadequate or uncontrolled ventilation;
c) improper or inadequate containment of construction activities;
d) improper or inadequate storage of construction materials;
e) disturbance of existing contaminated materials (e.g., disturbance of soil during excavation, removal of ceiling tiles, demolition of partitions);
f) disturbance or release, or both, of existing (or pre-existing) dust in patient care and other areas that could migrate, settle, and contaminate patient equipment, supplies, and other materials;
g) penetration of construction materials by water, and resultant stagnation;
h) repairs, modifications, or accidental incursions into water supplies;
i) contaminated materials brought to the construction site;
j) standing water on the construction site;
k) waste and leftovers from food and drink consumed on the site;
l) entry of vermin (e.g., rodents, insects, birds); and
m) inadequate cleanup and sanitation procedures.

4.3.3

Examples of HCF construction, renovation, and maintenance activities and occurrences that have been known to cause contamination producing infections and pseudo-infections include the following:

a) soil excavation:
    i) soil excavation near health care facilities; and
    ii) soil from construction contaminating the water supply;
b) heating, ventilation, and air conditioning systems (HVAC):
    i) air intakes or exhaust grilles in patient care rooms that are not covered during construction or demolition work;
    ii) changing of air filters in patient care areas or in systems supplying air to patient care areas;
    iii) demolition of ducts;
    iv) improper ventilation or failure of exhaust systems;
    v) failure to maintain air filters; and
    vi) inappropriate use of existing HVAC systems and ductwork to move HEPA-filtered air during construction;
c) windows:
    i) construction or demolition near windows that are open or improperly sealed;
    ii) improperly maintained or protected window and door openings which allow the migration of rodents or insects into the building;
    iii) window air conditioners facing road construction activity; and
    iv) disturbance of dust during work on window blinds;
d) failure of moisture barriers:
    i) leaking temporary or incomplete roofs;
    ii) leaking temporary walls or incomplete wall systems; and
    iii) failure at exterior joints; and
e) other activities and occurrences:
    i) carpeting that becomes contaminated during construction;
    ii) construction dust that contaminates supplies;
    iii) construction dust that enters an elevator shaft;
    iv) disturbance or removal of ceiling tiles;
    v) disturbance of contaminated wall coverings;

vi) dust barriers not erected before construction;
vii) dust from ceiling tiles contaminates microbiological plates and produces a false diagnosis;
viii) movement of staff or workers from contaminated worksite to patient care areas;
ix) leaks and flooding from water distribution systems, supply system plumbing, or drainage systems;
x) nearby construction work contaminates isolation rooms;
xi) food or drink left in wall cavities or ceiling spaces;
xii) removal of fibrous thermal insulating material (glass fibre); and
xiii) water supply repressurization that leads to descaling and release of biofilm organisms such as legionellae and mycobacteria.

5 Construction materials

5.1 Selection

5.1.1

Construction materials used in health care facilities should be selected for their ability to resist or prevent the growth and spread of micro-organisms, especially in areas where high-risk patients will be accommodated or treated. The project specifications shall include a statement regarding the selection and use of materials to meet the requirements of Clause 5 of this Standard and Clause 7.5 of CSA Z8000.

Notes:

1) *The unique operating characteristics of health care facilities create substantial physical stresses that can adversely affect the performance of construction materials. These characteristics include*
a) *frequent cleaning and disinfection of exposed surfaces;*
b) *constant high humidity levels in some areas;*
c) *frequent exposure of hand touch points to alcohol-based hand hygiene agents;*
d) *frequent upgrades to technical systems, and other changes that can affect the integrity of walls, ceilings, and floors; and*
e) *continuous operation of all systems within facilities.*

2) *The following reference also addresses material selection and design: PIDAC* Best Practices for Environmental Cleaning for Prevention and Control of Infections*.*

5.1.2

Construction materials should be selected that are not susceptible to moisture damage.

Note: *Construction materials that could be susceptible to moisture damage and resultant growth of biological organisms include*
a) *carpets;*
b) *cellulose insulation products;*
c) *fibre-based insulation products;*
d) *natural fibre products such as jute-backed floor coverings, cellulose insulation products, and ceiling tiles;*
e) *organic adhesives;*
f) *paper and paper-faced materials such as gypsum wallboards, panels, and wall coverings;*
g) *wood and wood products such as veneers;*
h) *wood-based composite core surfaces that use plastic laminate, metal, or other water—resistant surface materials;*
i) *woven fabrics and fabric-covered products; and*
j) *cork boards and panels.*

5.1.3

Wall materials used in the following locations and circumstances shall be faced with a water-impervious surface (e.g., fibreglass):

a) all walls and ceilings of bathrooms, showers, and kitchens;
b) walls and ceilings that are installed in locations where interior space is not yet protected or conditioned to control humidity (e.g., if interior construction has begun before the exterior walls are up); and
c) vertical and horizontal surfaces immediately adjacent to skylights (i.e., skylight surrounds).

Note: *There is a potential risk of water being trapped and mould forming when impermeable wall protection is used in*

a) *areas susceptible to excessive moisture or humidity that could breach or go around wall surfaces;*
b) *locations where water can come in behind the surface; and*
c) *areas where condensation can be a problem (e.g., exterior walls).*

5.1.4

Wall materials with a water-resistant surface should be used for the lower 1200 mm of exterior walls or up to window ledge whichever comes first.

5.1.5

Vinyl surface covering (vinyl wallpaper or wall protection sheets) shall not be used.

Note: *Use of this material can increase the risk of mould growth in the event that the wall becomes wet from the inside.*

5.1.6

Walls shall be designed and constructed in such a way as to minimize possible wicking of water under the sill.

Note: *This can be accomplished in different ways, for example by leaving a designed air space beneath the sill (provided that the wall does not need to be airtight), installing a gasket, or caulking.*

5.1.7

All walls should be flash coved to the floor.

Note: *The majority of water escapes could be significantly mitigated by preventing runs under walls that can occur with a standard vinyl cove base.*

5.1.8

Paper and paper-faced materials (e.g., gypsum wallboard, panels, ceiling tiles, and wall coverings) that have been damaged by moisture shall not be used.

5.1.9

Durable and corrosion-resistant plumbing materials shall be selected.

Note: *See also CSA Z317.1.*

5.2 Use of construction materials

5.2.1

Construction materials should be designed, handled, applied, and assembled using methods that will minimize the chance of contamination of spaces in the HCF.

5.2.2
The constructor shall ensure that water or moisture is not trapped in the building envelope system prior to applying the exterior skin.

Note: *This also applies to horizontal surfaces, for example if there is water on a metal roof deck prior to installing the roof insulation or membrane.*

5.3 Shipping, handling, and storage of construction materials

5.3.1 General

5.3.1.1
Materials for temporary or permanent installation in the building interior shall be protected from exposure to dust and moisture during delivery to the site, unloading, storage, and construction.

5.3.1.2
The constructor shall ensure that a documented inspection and verification program is in effect with regard to the shipping, handling, and receiving of materials susceptible to moisture damage and dust build-up before such materials are accepted and used. Constructors should avoid stockpiling susceptible materials in exposed areas.

Notes:

1) *Susceptible materials include porous building materials such as insulation and drywall, and any materials that will be installed in the interior of the building.*

2) *Cellulose-based materials that have been exposed to elevated relative humidity or free-standing water are at higher risk for developing mould amplification sites.*

5.3.2 Construction materials susceptible to contaminants and moisture damage

5.3.2.1
Construction materials that are susceptible to contaminants and moisture damage shall be delivered to the construction area in a way that ensures that they are not exposed to contaminants or excessive moisture.

Note: *Moisture testing of materials arriving on site is easily done with inexpensive portable detectors.*

5.3.2.2
The requirements of Clause 5.3.2.1 shall be accomplished by either

a) wrapping the materials in an impervious plastic wrap for shipping and handling. Measures shall be taken to ensure that the wrap is not damaged during shipping or handling;

b) loading and unloading of materials at indoor facilities and delivering the materials in enclosed vehicles. In such cases, loading and unloading shall not occur in weather that could subject the materials to moisture (e.g., rain, snow, or heavy fog); or

c) using another method that provides sufficient protection to the construction materials.

5.3.2.3
If a moisture-susceptible material has been exposed to moisture, it shall be tested before installation to determine whether moisture contamination or damage has occurred. Construction materials that have become contaminated or damaged by moisture shall be decontaminated or replaced as directed by the MDT. See Clause 9.

Construction materials shall be determined to have been damaged by moisture if they exceed the following wood moisture equivalent values:

a) wood and lumber with a percent moisture content wood scale > 17%;
b) wood panel products (e.g., oriented strand board or plywood) with a percent moisture content wood scale > 8%;
c) fabricated wood I-joists with a percent moisture content wood scale > 16%; or
d) gypsum wallboard with an internal moisture content > 12% (or > 0.7% using a drywall moisture equivalency scale).

Note: *These values are not absolute. They are meant to be used and interpreted in the context of professional judgment.*

5.3.2.4

In Population Risk Group 4 areas of Construction Activity Type C or D, where the use of paper-faced gypsum wallboard is typically used and the adjacent occupant area above has considerable water infrastructure, the use of water-resistant wall materials (e.g., fibreglass faced wallboard) should be considered as a potential preventive measure against the formation of mould and thus risk to patient care exposure.

Note: *See Table 2 for a description of the risk groups.*

5.3.3 Mechanical equipment and ductwork

5.3.3.1

The HCF shall have documentation specifying the responsibilities of the HCF, the constructor, consultants, and other involved parties for maintaining the cleanliness of mechanical equipment and ductwork at each stage of the construction project. It shall ensure that each of these parties is aware of its responsibilities. The documentation shall include

a) the measures to be taken by all parties to maintain cleanliness of the system; and
b) the maintenance and testing activities that are to be done at each stage.

5.3.3.2

Mechanical equipment (e.g., diffusers, air handling units, and terminal boxes) shall be shipped to the construction area in a way that ensures that the equipment is not exposed to contaminants or excessive moisture.

5.3.3.3

Openings in mechanical equipment and ductwork shall be securely sealed before shipping to prevent the entry of dust. Measures shall be taken to ensure that seals are not damaged during shipping or handling. Equipment shall remain protected until it is installed and functioning without interruption.

5.3.3.4

Ductwork shall be handled and installed in accordance with the “Advanced Level” requirements in SMACNA’s *Duct Cleanliness for New Construction Guidelines*. Ductwork shall remain sealed until it is incorporated into the work.

Note: *Annex I provides guidance on HVAC installation methods.*

5.3.3.5

Exposed openings of installed ductwork shall remain sealed until construction has reached the final connection/completion stage and filtered air flow is provided without interruption. However, in new

construction only, supply ducts may be unsealed if they are used for temporary heating or cooling during construction as provided in Clause 8.2.17.

5.3.3.6

Return air system duct work shall remain sealed until

a) the permanent air handling equipment is running without interruption;
b) the duct work systems have been cleaned in accordance with Clause 5.3.3.7; and
c) the building has been cleaned to a state that it would be considered to be at Phase 4 of construction in accordance with Clause 8.3.5.

5.3.3.7

At the completion of construction, all ductwork shall be cleaned in accordance with *NADCA General Specifications for the Cleaning and Restoration of Commercial Heating, Ventilating and Air Conditioning Systems* and
CSA Z317.2.

5.3.4 Woven fabrics, fabric-covered products, and wood-based composite core products with veneers

Woven fabrics, fabric-covered products, and wood-based composite core products with veneers shall not be delivered to the construction area until the area(s) in which they are to be stored and/or installed are determined to be free from significant risk of water intrusion. If the products are exposed to contaminants during storage, they shall be cleaned before installation. Materials that cannot be safely and effectively cleaned shall be discarded.

Storage spaces for these materials shall be climate controlled. The climate control system shall maintain an environment where the humidity and temperatures are within 20% of the final operating specifications for the building environmental controls (e.g., temperature of 16 to 25 °C and humidity between 20 and 40%).

Note: *Depending on the nature of the project, storage spaces could be off site (e.g., a warehouse) or on site (e.g., a designated space within the project where temperature and humidity are controlled and where items can be safely stored).*

6 Procedures

6.1 General

6.1.1

Appropriate infection prevention and control measures shall be used and appropriately documented throughout the life of a construction project. The processes and procedures in this Standard shall be followed on all construction projects, no matter what method of contract and delivery is used. If the sequence of construction is changed because of time constraints or other considerations (e.g., drywall going up before the exterior walls are on), constructors shall take such additional precautions as are necessary to protect building materials and equipment from dust, contamination, and moisture.

6.1.2

For maintenance projects, and for renovation projects not categorized as new construction, the requirements of Clause 7 shall apply. For new construction projects, the requirements of Clause 8 shall apply.

Note: *See Clause 8.1.3 regarding categorization of new construction and renovation projects.*

6.1.3

An infection control risk assessment (ICRA) shall be conducted before construction begins on any project involving preventive measures III or IV (PM III or IV). For other projects, an ICRA should be conducted. If an ICRA is not being done (e.g., for a small project in a low-risk area), there shall be an assessment of occupied areas adjacent to the construction area, and the systems serving those areas, to identify potential risks to the occupants.

6.1.4

Based on the ICRA or the risk assessment conducted under Clause 6.1.3, the MDT shall perform a preventive measures analysis to identify and document the preventive measures necessary to protect patients and staff from construction-related infection risks.

6.1.5

For renovation and construction projects, the constructor or their qualified representative (e.g., infection prevention and control consultant) shall develop a written infection control plan for the specific construction project, which shall be consistent with the requirements of this Standard. The plan shall describe the procedures, processes, and safeguards that will be used to maintain the appropriate infection control preventive measures throughout the project.

6.1.6

The MDT shall review the infection control plan prior to project commencement to ensure it satisfactorily addresses the necessary preventive measures, as identified through the preventive measures analysis. Work shall not commence until the infection control plan has been reviewed and accepted by the MDT. A copy of the infection control plan shall be included in the contract documentation along with a contractual requirement to comply with its relevant provisions.

Notes:

1) *This step is part of a sequence of events that includes*
   a) *HCF identification of potential risks, which in many cases will be done through an ICRA;*
   b) *communication of risks and preventive measures in tendering documents;*
   c) *contractor (or HCF internal staff on a small project) development of infection control plan that is appropriate to the project and to the needs of the HCF, and which complies with this Standard. This plan will specify the preventive measure program that will be followed;*
   d) *MDT approval of the infection control plan;*
   e) *implementation of the infection control plan, including the necessary training of personnel; and*
   f) *updating of the infection control plan as needed throughout the project.*

2) *This Standard does not address the HCF's own operational plan for infection prevention and control during the project.*

3) *See Annex D for a sample table of contents for an infection control plan.*

4) *The timing of the approval of the infection control plan can vary in the case of Category 1 (greenfield) construction.*

6.1.7
The constructor leadership shall have demonstrated experience and knowledge of the principles and practices of infection control during construction.

Note: *Experience and knowledge of infection control during construction may be demonstrated, for example, by presenting proof of training classes completed, documentation showing work on HCFs in the past, or work performed with experienced supervisors.*

6.1.8
Workers shall be trained in the key elements of the preventive measures within the project-specific infection control plan, appropriate to the scale of the project and the potential risks associated with it.

6.1.9
The procedures, processes, and safeguards for infection prevention and control during the project shall be clearly outlined in the relevant construction documents (e.g., drawings, specifications, tender or bid documents, or work orders) before any construction project is started and they shall be maintained for the duration of the project.

6.1.10
The infection control plan shall be implemented at the beginning of the project and monitored throughout the project regarding its effectiveness in maintaining infection prevention and control. The plan shall be updated as needed during the course of the project regarding its effectiveness in maintaining infection prevention and control. If the scope of the construction activity changes, the ICRA, preventive measures analysis, and infection control plan shall be updated, or if necessary replaced, to reflect the changes.

6.1.11
The MDT shall develop a monitoring plan that specifies the periodic checks that should be done during the project to confirm the infection control plan is being followed. The frequency of these checks shall be defined in the monitoring plan.

6.1.12
For a construction project within or connected to an existing facility, the planning process shall include an assessment of the relevant structural and mechanical elements of the building to identify potential infection control problems. The inspection shall include the exterior structure, spatial separations (e.g., walls, partitions, floors, and floor slabs), ventilation system, and water supply.

6.1.13
Heating, ventilation, and air conditioning systems around the construction zone shall be regularly assessed by qualified personnel to ensure that the air pressure, air flow, air exchange rates, and filtration systems are working as designed during construction. The frequency of this assessment shall be established by the MDT based on the construction type and location, and documented in the preventive measures analysis.

6.1.14
Infection control problems that have been identified in the planning or preparation for construction shall be corrected prior to commencing construction. Problems that occur during construction shall be corrected promptly. Any situation that poses a risk to patients or staff shall be immediately reported and corrected.

6.1.15

The infection control plan shall include written procedures for a stop work intervention when it is needed for infection prevention and control during construction. The procedures shall be in place before construction starts and they shall address the following:

a) lines of authority;
b) communications protocols to be followed before and after the stop work intervention is issued, including contact information for essential personnel;
c) investigation of the conditions that led to the stop work intervention; and
d) processes to ensure that the necessary remediation has taken place prior to restarting activity.

6.1.16

Food and drink (other than water) should be prohibited on all construction sites, except in specially designated eating areas (e.g., a lunch room or trailer).

Note: *Food and drink, and the resulting crumbs, spills, and debris, can promote the growth of micro-organisms. Items left in wall and ceiling spaces can present a long-term risk of contamination, leading to an occupancy hazard that can persist long after the work is complete.*

6.2 Multidisciplinary teams

6.2.1 General

6.2.1.1

A well-managed site MDT with site knowledge and appropriate expertise (see Clause 6.2.2) shall be involved throughout a construction project beginning at the initiation stage. As part of the formation of the team, a chair or lead shall be established.

Note: *MDTs can vary in size, scope, and time of service depending on the type of HCF and the level of construction activity. In a larger regional health system, MDTs would generally be maintained as follows:*

a) ***Project MDT*** *— a project-specific MDT created to ensure compliance with this Standard during development, design, tendering, construction, and commissioning of a project. See Clause 6.2.3;*
b) ***Site MDT*** *— a standing team located at sites that have continuous construction. The site MDT provides representatives for project MDTs and also for ongoing maintenance operational activities. See Clause 6.2.2; and*
c) ***Permanent MDT*** *— a standing MDT, usually serving a health region or consortium, that provides a technical resource and overview for consistent application of this Standard to Site MDTs. See Clause 6.2.1.6.*

If more than one MDT will be involved in a construction project (e.g., a project taking place within in a larger health region), the HCF shall define beforehand the lines of communication, coordination, and authority between the teams and shall establish a documented process through which potential conflicts will be resolved.

6.2.1.2

The MDT shall participate in the project planning.

6.2.1.3

The MDT shall provide guidance for the project management team to assist in the incorporation of this Standard's requirements into all phases of the project, including planning, design, implementation phases, commissioning, occupancy, and maintenance.

6.2.1.4

If, during the project, the MDT identifies additional measures or design features that could protect current or future occupants, it should present these to the project management team as additional recommendations. See Annex A.

6.2.1.5

MDTs shall include members with expertise in the following areas:

a) infection prevention and control;
b) administration;
c) project management;
d) environmental services;
e) clinical care (e.g., health care staff);
f) occupational health and safety;

   Note: *The occupational health and safety experts on the MDT should maintain coordination with the HCF's existing health and safety committees, either through formal communications links or through overlapping membership.*

g) design (e.g., architects, engineers);
h) operation and maintenance; and
i) construction.

Note: *One individual may represent multiple areas of expertise.*

6.2.1.6

A site MDT shall be established in any HCF where there is frequent construction. Where health care facilities are grouped into health authorities or a similar regulatory body, the central organization shall also have a permanent MDT to provide leadership and consistency.

6.2.2 Site MDT

Each HCF site shall have a site MDT that includes the following personnel associated with the specific site:

a) infection prevention and control professionals (ICPs);
b) health care administrators;
c) health care staff (e.g., medical, nursing, and medical support services);
d) operation and maintenance;
e) environmental and support services; and
f) other personnel as appropriate to the administrative structure of the HCF.

During large or complex projects, the team may also include the site construction manager.

6.2.3 Construction project MDT

When preparing for significant construction (i.e., Type C or D), the project leadership shall establish a construction project MDT that shall include the site MDT (see Clause 6.2.2) and that shall also include the following:

a) the HCF's project and construction management representatives;
b) the primary consultant;
c) additional project consultants as appropriate to the project (e.g., the infection prevention and control consultant); and
d) the construction management contractor (e.g., the HCF's construction management contractor when engaged).

For new construction and major renovations, the MDT shall include infection prevention and control staff from the facility being constructed or renovated.

6.3 Personnel and their responsibilities

6.3.1 General

Note: *Clauses 6.3.2 to 6.3.9 outline the responsibilities of some of the key professionals involved in construction projects in health care facilities and show how collaboration within the MDT can decrease the risk of infections.*

6.3.1.1

If there is a possibility that construction will affect Population Risk Group 3 or 4 high-risk patients, the infection prevention and control department shall be notified in advance in accordance with HCF policies.

Note: *Sufficient advance notice allows infection control personnel to make the appropriate preparations and organize alternative arrangements if needed. Ideally, notice should be provided at least three business days in advance.*

6.3.1.2

The responsibilities assigned to particular professionals in Clauses 6.3.2 to 6.3.9 may be reassigned by contract or through policies and procedures established by the HCF.

6.3.1.3

The owner and the consultant or primary consultant should review their project contract or terms of engagement, and amend it if necessary to ensure it is in accordance with this Standard.

6.3.1.4

The roles and responsibilities of each member of the MDT shall be clearly outlined and documented.

Note: *For infection prevention and control measures to be successful, it is essential to have a high level of commitment, understanding, and co-operation from all personnel involved in the project.*

6.3.1.5

All personnel involved in a construction project shall be informed of the potential risks that construction activities can present for patients, staff, and the public, along with their responsibilities to mitigate that risk. Preventive measures shall be in place before any personnel involved with the project visit, inspect, or work on the project. The applicable information shall be provided in the form of written guidelines (with sign-off for quality assurance) and should be complemented by oral instructions from trained personnel.

Note: *The HCF should have an organized plan to disseminate relevant information to staff who need to perform activities or could be affected by others' activities. Information should be conveyed using the communications methods that are most likely to reach and be acted on by those affected.*

6.3.2 Infection prevention and control professional (ICP)

Note: *For more information on the role of the ICP, see Annex B.*

6.3.2.1

The ICP shall ensure that the members of the MDT are adequately educated on the need for preventive measures to decrease construction-related infections.

6.3.2.2

The ICP shall

a) be an active member of the MDT throughout the life of the construction project, from the planning stage to the final evaluation after completion of the work;
b) ensure that the appropriate preventive measures are initiated and adhered to; and
c) monitor changes in infection rates and patterns during and immediately after construction, renovation, maintenance, or repairs.

Note: *Surveillance should augment preventive strategies during construction and renovation projects. Baseline levels of health care-acquired airborne and waterborne infections should be determined prior to commencement of the construction project.*

6.3.2.3

Any member of the MDT shall have the authority to stop construction if there is a significant failure to adhere to the required preventive measures. The MDT shall have a procedure in place for notifying relevant HCF and construction management personnel in the event of a construction stop.

6.3.3 Administrators

The HCF's administrators shall ensure that the HCF has policies and procedures that clearly outline the necessary infection prevention and control measures and the related responsibilities of participants in the construction project.

Note: *The HCF's administrators should also ensure that the MDT includes personnel with the appropriate knowledge and experience to identify and implement the necessary infection prevention and control measures. In HCFs that do not regularly engage in construction projects, the use of outside experts should be considered.*

6.3.4 Facility project manager

The facility project manager shall be responsible for

a) overseeing and coordinating the activities of HCF personnel and consultants involved in the construction project;
b) managing information flow among members of the MDT;
c) deciding who is represented at planning, design, construction, and commissioning meetings; and
d) ensuring that consultants and constructors selected for a construction project understand the requirements of this Standard, and their responsibilities in carrying out these requirements.

Note: *If an organization other than the HCF is the contract holder for a construction project (e.g., a provincial/ territorial infrastructure agency), that organization would provide documentation to the HCF sufficient to demonstrate compliance with this Clause.*

6.3.5 Environmental services personnel

Environmental services personnel shall be responsible for keeping areas adjacent to the construction area and the occupied areas of the HCF clean and clear of obstructions.

The responsibility for cleaning adjacent areas shall be determined and documented before construction begins.

Note: *In some cases, the constructor will designate the person responsible for cleaning the adjacent areas.*

6.3.6 Health care staff

6.3.6.1

Health care staff (including medical and nursing staff) shall be responsible for maintaining patients' health and safety with respect to construction-related hazards. Before the start of construction they shall conduct an assessment to identify

a) patient populations at risk;
b) potential hazards that construction activities pose to patients; and
c) the relevant preventive measures.

Note: *Increased awareness on the part of health care staff, as specified in this Clause, promotes identification of deficiencies in dust containment and the timely investigation of situations where patients are suspected of having acquired pneumonia in the HCF.*

6.3.6.2

Infection prevention and control personnel shall collaborate with the health care staff to identify patients at risk of acquiring construction-related infections (e.g., immunosuppressed patients).

6.3.7 Design and management professionals

6.3.7.1

Design professionals, including architects and engineers, shall be responsible for providing design and construction documentation that meets the requirements of this Standard and the infection prevention and control objectives of the HCF (e.g., the design of dust barriers or the control of recirculated air). Design and management professionals should consult the MDT as needed to develop this documentation.

6.3.7.2

The documentation shall form part of the construction agreement with the constructor.

6.3.7.3

Design professionals shall be responsible for issuing instructions to the constructor during construction on behalf of the HCF and the MDT.

6.3.8 Operation and maintenance staff

6.3.8.1

Operation and maintenance staff shall be made aware of the building occupants who could be at risk and the impact that the project could have on construction-related infections (see Tables 2 and 3).

6.3.8.2

During renovation projects to an existing site (including additions), operation and maintenance staff shall coordinate with the constructor to ensure that the HCF systems at the construction site are isolated from the facility systems in the occupied part of the facility to prevent contamination of air, water, medical gas, and other systems.

6.3.8.3

The maintenance manager shall work with the constructor to maintain constant air flow from the HCF toward the construction area. Air systems used to control relative pressurizations in the construction

area and adjacent areas within the HCF shall be checked at least daily by operation and maintenance staff to ensure continued operation and constant relative pressurization. If these air systems are controlled by a central automated system, the operators of the automated system shall monitor the status of the air systems and any associated alarms.

6.3.8.4

Demolition activities occurring outside, e.g., soil excavation and building demolition, can potentially introduce greater-than-normal amounts of dust into the fresh air intakes of a nearby facility. During heavy construction, air system filters should be monitored at least daily and replaced if necessary to maintain the design parameters of the air handling systems.

Note: *Relocation of air intakes can help to prevent overloading of filters.*

6.3.8.5

Proper maintenance of facility systems is essential for providing a healthy environment for patient care. Operation and maintenance staff shall be involved in the commissioning of systems in newly constructed and renovated areas in order to become familiar with their operation. Maintenance managers shall ensure that the operation and maintenance staff is appropriately trained on these systems so that future maintenance can be properly performed.

Note: *Refer to CAN/CSA-Z8001 for details on the role of operation and maintenance staff during commissioning.*

6.3.9 Constructors

6.3.9.1

During construction, constructors shall

a) implement the preventive measures identified by the MDT;
b) supply, erect, and maintain the integrity of all barriers between the construction area and adjacent areas of the HCF;
c) maintain the construction site ventilation system(s) by
    i) monitoring, maintaining, and logging temperature and humidity; and
    ii) providing weekly trend logs and correcting as required;
d) keep contaminant generation at the construction site within acceptable limits;
e) be responsible for maintaining construction clean protocols at the construction site;
f) be responsible for the actions of their employees and sub-trades;
g) be responsible for the physical security of the construction zone; and
h) ensure that materials are kept clean and dry during delivery, storage, and installation.

6.3.9.2

Constructors and facility managers shall ensure that all gaps, holes leading to adjacent areas, and floors above or below the construction area are securely sealed.

6.4 Plumbing and ventilation systems

6.4.1

Prevention of construction-related infections shall include management of plumbing and ventilation systems to

a) control dust generated during demolition and construction;
b) prevent dust infiltration into patient care areas, laboratories, food preparation areas, and diagnostic areas;

c) prevent generation of aerosols from contaminated water sources; and
d) minimize infection risks from cooling towers for HVAC systems (see Clause 6.4.2).

6.4.2

HVAC system cooling towers shall be maintained as follows:

a) Cooling towers that have been taken out of service during construction shall be cleaned (or flushed and disinfected) in accordance with the manufacturer's recommendations before being put back into service.

   Note: *The terms "cleaning", "flushing", and "disinfection" are used differently when applied to HVAC cooling towers than they are when applied to HCF activities such as environmental cleaning and medical device reprocessing.*

b) Once in service, cooling towers should be continuously operated and maintained. The respective responsibilities for operation and maintenance activities shall be clearly defined between the HCF, the constructor, and other involved parties.
c) In-service cooling towers shall be cleaned (or flushed and disinfected) quarterly, in accordance with the manufacturer's recommendations.
d) Cooling tower water systems should have a biocide water treatment program. The products used in such a program shall be compatible with the manufacturer's recommendations. The treatment regime should rotate between products to prevent the development of resistant micro-organism strains.
e) Water quality in the cooling tower systems shall be maintained in accordance with the equipment manufacturer's instructions. When topping up the system to replace water losses due to bleed or blow-down, rust inhibitors and biocide shall be added as needed to maintain the recommended water treatment quality.

Cooling towers and evaporative cooling equipment that are out of service for more than three days should be drained.

Note: *If it is not practical to fully drain the cooling tower system, then the fill section should be bypassed while treated water is circulated throughout the remaining system equipment. The biocide treatment program should be resumed, starting with administration of a shock treatment with the appropriate biocide, before operating the cooling tower fans and putting the cooling tower back into full service.*

6.4.3

A regular program of preventive inspection and maintenance shall be in place for the HCF's plumbing and ventilation systems. Maintenance and inspection shall be more frequent and rigorous in high-risk areas.

Note: *CSA Z317.1 and CSA Z317.2 provide additional information and requirements regarding maintenance of plumbing and HVAC systems, respectively.*

6.5 Preventive measures analysis

6.5.1

Table 1 identifies the preventive measures that shall be applied by the MDT during the project design process.

6.5.2

The preventive measures analysis shall be performed in accordance with Table 1 after identifying the following characteristics of the project:

a) the population risk group (1, 2, 3, or 4) in accordance with locational criteria specified in Table 2;

b) the construction activity type (A, B, C, or D) in accordance with the activity-related criteria specified in Table 3; and
c) the preventive measure type (I, II, III, or IV) by referring to the cell in Table 1 where the row for the applicable population risk group and the column for the applicable construction activity type intersect.

6.5.3

Results of the preventive measures analysis described in Clause 6.5.2 shall be recorded on the preventive measures analysis form or an equivalent form.

Note: *See Annex C for a sample preventive measures analysis form.*

6.5.4

Because PM III and IV relate to projects of long duration in high-risk areas, a copy of the completed preventive measures analysis shall be provided to the HCF's infection prevention and control department. Changes to the preventive measures shall only be made with the approval of the MDT responsible for the project.

Note: *See Annex C for a sample preventive measures analysis form.*

6.6 Air quality

6.6.1 Dust control

6.6.1.1

Appropriate methods shall be used to prevent the migration of dust particles from the construction area to the occupied areas of the HCF.

Note: *The dust control methods used will vary depending on the level of preventive measures being applied, as well as other factors such as proximity of occupied areas to the construction area.*

6.6.1.2

For projects under PM III and IV, dust control methods shall include the following:

a) Personnel shall check for leakage paths between the construction area and adjacent areas of the HCF. Wind and stack effects shall be considered, and steps shall be taken to plug holes in spatial separations (e.g., walls, partitions, floors, and floor slabs) and to seal gaps.

   Notes:

   1) *Wind effects can be caused by*
      a) *direct wind pressure on building surfaces; or*
      b) *wind blowing over an opening and consequently drawing air out of a building (Venturi effect).*

   2) *Stack effects can be caused by convection, i.e., warm air being drawn up in a high space and pulling in air from below.*

b) Windows, doors, and air intake and exhaust vents in areas of the HCF adjacent to construction areas shall be sealed, especially around buildings that are going to be demolished. Areas housing patients who are most susceptible to infections (see Clause 4.2.1) shall be sealed off from the construction area to prevent air leaks into the patient care areas.

   Note: *Fire codes and other regulatory requirements can apply to the sealing of a building exit.*

c) The construction area shall be sealed off from occupied areas using one or a combination of the following barriers:
   i) a solid impermeable dust barrier, in accordance with Clause 7.3.3.2.1 a);
   ii) an anteroom when at PM IV (see Clause 6.6.2); or

iii) an impermeable temporary containment unit (vessel) constructed to contain dust and other contaminants. See Clause 7.3.3.2.1 b).

Barrier selection shall be appropriate to the preventive measure in effect, as specified in Clauses 7 (for repairs, renovation, and maintenance) and 8 (new construction). Where deemed appropriate by the MDT, the composition of the barrier may be modified to suit time, space, or impact constraints. Alternative forms of construction or containment products may be used if they can be shown to provide an equivalent barrier.

6.6.1.3

The total negative pressure differential from all adjacent occupied areas into the construction area shall be maintained at a minimum of 7.5 Pa. On construction sites using PM III or IV, there shall be a monitoring device that constantly displays the pressure differential between the construction area and occupied areas (and the anteroom, if used).

Note: *The 7.5 Pa pressure differential is intended to ensure continued directional airflow from clean to dirty areas under all conditions. While a smaller differential could theoretically accomplish this, this value provides a margin of safety in recognition that real world conditions can disrupt planned air flows, e.g., through equipment inefficiencies or failure, opening and closing of doors, or gaps in the construction barrier. The 7.5 Pa pressure differential helps to ensure that wherever there is a breach in the construction air envelope, whether visible or invisible, air will always flow inward.*

6.6.1.4

When anterooms are used (e.g., for PM IV), the negative pressure differentials from occupied areas to the anteroom shall be at least 2.5 Pa. The minimum total pressure differential of 7.5 Pa between adjacent occupied areas and the construction area shall be maintained regardless of the anteroom pressure. See Figure 1.

Note: *The pressure differential between the occupied areas and the anteroom may be periodically measured. This should be done at the beginning and periodically thereafter (at least while the risk is highest, e.g., during heavy demolition).*

6.6.1.5

Intermittent disruptions to pressure differentials may be made under controlled conditions, provided that they are planned for and documented by the MDT before construction begins. The infection control plan shall include procedures to be followed if an unexpected disruption takes place, including the necessary notifications, conditions under which the MDT would become involved, and remedial measures to be taken following a disruption.

Note: *An example of a planned disruption would be when both doors are open to allow a large item to move through.*

6.6.1.6

CAHUs shall be run after the completion of construction for a period of time sufficient to remove airborne contaminants in PM III and IV areas (see Table 4).

Means shall be used to generate air movement within the zone sufficient to mix the air so that contamination is captured in the exhaust.

Notes:

1) *Table 4 specifies the minimum time needed for a CAHU to achieve this level of dust removal.*

2) *The volume and direction of the air circulation should be such that dust and debris are not lifted from the floor.*

3) *Perfect mixing does not usually occur. Removal times will be longer in rooms or areas with imperfect mixing or air stagnation. Caution should be exercised in using Table 4 for such situations.*

6.6.1.7

Construction, maintenance, and repair area exhaust air shall not be discharged to areas occupied by Population Risk Group 3 or 4. Measures related to recirculated air shall require approval from the MDT. If recirculated air is used, the MDT should arrange for on-site and in-place performance leak testing of the CAHUs.

6.6.1.8

Temporary flexible ducts shall be durable enough to withstand the wear and potential stresses that they could be exposed to in the environment where they will be used. Temporary ducting shall be inspected for leaks prior to installation and inspected daily for leaks and damage during the work period. Temporary ducting that has been used on the intake side of a CAHU (i.e., upstream of HEPA filters) should not be reused. Where temporary ducting is reused between jobs, it shall be cleaned before reuse and only used upstream of the HEPA filters.

Note: *Leaks can result in contamination of corridors or spaces traversed by the duct.*

6.6.1.9

Walk-off mats shall be of sufficient size to ensure that constructors have to place both feet on the mat at least once on exiting the construction area. The material used for the walk-off shall be appropriate to the site, the expected traffic level, and the type of soil that is likely to be tracked. They shall be maintained as follows:

a) Dry mats shall be vacuumed daily with a HEPA filter-equipped vacuum cleaner, as well as when visibly soiled. Soiled mats that cannot be cleaned shall be replaced.
b) Carpet sections, if used, shall be of a synthetic material that can be thoroughly and easily cleaned with a HEPA-filtered vacuum.
c) Adhesive mats (also referred to as sticky mats) shall be replaced when visibly soiled.

   Note: *Adhesive mats should be replaced at least daily when there is heavy traffic to and from the construction area.*
d) For mats that rest in antibacterial solution, the solution shall be changed as recommended by the manufacturer of the mat.
e) If an anteroom is used, there shall be two walk-off mats:
   i) one inside the door from the construction area to catch debris from workers exiting the construction area; and
   ii) another outside the door leading to the occupied areas to catch any remaining dust and debris tracked from the anteroom floor. See Figure E.4.

6.6.1.10

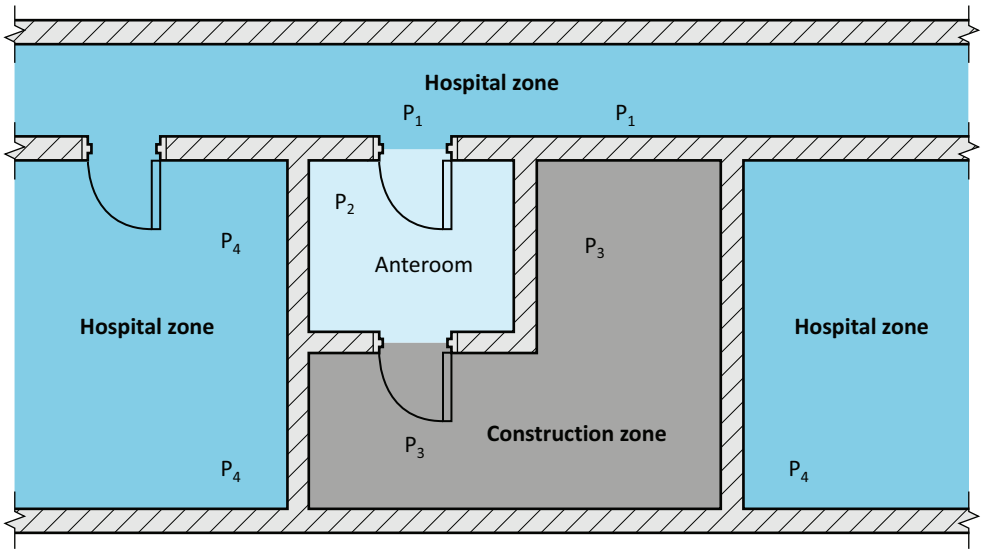
Boot scrubbers or boot wash stations, or both, where used, shall be placed at the exit of the construction area, and shall be regularly maintained and cleaned to prevent accumulation and potential spread of debris, dust, or dirt to areas outside the construction zone. These shall be maintained as follows:

a) boot scrubbers shall be of a synthetic material that can be cleaned with a HEPA-filtered vacuum;
b) cleaning shall occur daily as well as when visibly soiled;
c) the floor areas around the boot scrubber shall also be cleaned per the requirements of Item b);
d) only initially potable water shall be used in boot wash stations; and
e) water shall be changed frequently, and when visibly dirty.

6.6.1.11

Pressure differential monitoring devices and other equipment used to measure or monitor differential pressure shall be calibrated and maintained as recommended by the manufacturer and the calibration and maintenance shall be documented.

Figure 1
Pressure differentials for a construction zone
(See Clause 6.6.1.4.)



Example:

$P_1 > P_2$, minimum differential 2.5 Pa
$P_2 > P_3$, minimum differential 2.5 Pa
$P_1 > P_3$, minimum differential 7.5 Pa
$P_4 > P_3$, minimum differential 7.5 Pa

P_1 and P_4 = Occupied areas (hospital zone)	P_2 = Anteroom	P_3 = Construction zone

Note: *Pressure differentials are intended to produce continual air flow from the hospital zone, through the anteroom and into the construction zone. The following examples show how the requirements in Clause 6.6.1.4 could be met using different figures for relative pressurization between construction zone, anteroom, and hospital zone. The continuous monitoring requirement in this Standard applies only to the total pressure differential construction zone to hospital zone (i.e., 7.5 Pa):*

Example 1:
P1 – P2 = 3.0 Pa
P2 – P3 = 4.5 Pa
— — — — — —
Σ = 7.5 Pa
***Compliant** — Pressure differential between adjacent areas is no less than 2.5 Pa and the total is at least 7.5 Pa.*

Example 2:
P1 – P2 = 2.5 Pa
P2 – P3 = 5.0 Pa
— — — — — —
Σ = 7.5 Pa

Compliant *— Pressure differential between adjacent spaces is no less than 2.5 Pa and the total is at least 7.5 Pa.*

Example 3:
P1 – P2 = 5.0 Pa
P2 – P3 = 2.5 Pa
— — — — — —
Σ = 7.5 Pa
Compliant *— Pressure differential between adjacent spaces is no less than 2.5 Pa and the total is at least 7.5 Pa.*

Example 4:
P1 – P2 = 4.5 Pa
P2 – P3 = 4.5 Pa
— — — — — —
Σ = 9.0 Pa
Compliant *— Pressure differential between adjacent spaces is no less than 2.5 Pa and the total is at least 7.5 Pa.*

Example 5:
P1 – P2 = 1.0 Pa
P2 – P3 = 6.5 Pa
— — — — — —
Σ = 7.5 Pa
Non-compliant *— Pressure differential between occupied areas and anteroom is less than 2.5 Pa.*

Example 6:
P1 – P2 = 3.0 Pa
P2 – P3 = 3.0 Pa
— — — — — —
Σ = 6.0 Pa
Non-compliant *— Total of pressure differentials is less than 7.5 Pa.*

Example 7:
P1 – P2 = 7.5 Pa
P2 – P3 = 7.5 Pa
— — — — — —
Σ = 15.0 Pa
Compliant *(although well exceeding minimum requirements for pressure differentials).*

6.6.2 Negative air anteroom

6.6.2.1

A negative air anteroom, if used, shall be a sealed space constructed as follows:

a) The anteroom should be large enough so that most materials and supplies can be moved through it without having to open both doors at the same time.
b) The configuration of the anteroom and the construction site shall be such that it creates a continuous air-resistant boundary between the hospital zone and the construction zone.
c) There shall be a door at either end, and doors shall be equipped with closers.
d) The walls should be built of metal studs, spaced at 40 cm on centre, the bottom track sealed to the flooring, two layers of 6 mil poly sealed to the studs, one on either face and protected with drywall

with a wipeable surface. For temporary structures to separate construction areas from patient-occupied areas, the plane closest to the occupied side shall be wipeable.

Notes:

1) *The 6 mil poly may be installed on one side only if trapped moisture is a concern.*

2) *A wipeable surface includes any smooth surface (e.g., vinyl veneer, painted surface, or smooth plastic product) that can be easily cleaned using hospital grade cleaning products.*

e) The elements of the anteroom shall combine to provide an air resistant barrier that extends from the floor to the full height of the ceiling or the underside of the deck. The anteroom shall be sealed at the top, either with barrier material at the false ceiling or by direct connection to the underside of the ceiling deck.

Notes:

1) *The construction requirements in this Clause are intended to create a sealed space.*

2) *To maintain the seal, either the entrance or exit wall of the anteroom should be constructed to underside of deck and any openings sealed. The constructor might need to extend the wall barriers above the false ceiling throughout the space, as leaks above the ceiling can make it difficult to establish and maintain pressure differentials. Alternatively, barrier material may be installed below the false ceiling.*

3) *The connection at the ceiling depends on the stage of construction. The connection between the 6 mil poly and the deck may be achieved with the use of construction-grade sealing tape.*

6.6.2.2

Where deemed appropriate by the MDT, the composition of the barrier may be modified to suit time, space, or impact constraints. Alternative forms of construction or containment products may be used if they can be shown to provide an equivalent barrier.

Note: *A negative air anteroom installed between buildings is generally the best way to achieve and maintain separation and control dust during construction.*

6.6.2.3

Walk off mats or sticky mats shall be provided in the direction of the dirty side into the clean side. See Clause 6.6.1.9.

6.6.2.4

Negative air pressure shall be maintained through the use of CAHUs with sufficient capacity to achieve a minimum of minus 2.5 Pa in the anteroom, relative to the hospital zone. The CAHUs shall be inspected at least once a day and filters shall be changed, as specified in the manufacturer's instructions. A permanent log of these inspections shall be attached to the filter unit and signed and dated at each inspection by the person maintaining the units. For projects using PM III, the pressure differential monitoring device should be connected to an integral data recorder. For projects using PM IV, the pressure differential monitoring device shall be connected to an integral data recorder.

Note: *For larger projects, there should be a plan to coordinate and centralize the alarm system, so that alarm trigger pressures, signals, and monitoring are consistent across the site.*

6.6.3 Air filtration

6.6.3.1

Air exhausted from construction areas shall be HEPA-filtered.

6.6.3.2

The HEPA filters used shall have a collection efficiency of 99.97% at 0.3 µm, and their performance shall have been tested by a qualified tester and verified as meeting recognized standards.

Note: *These performance requirements are consistent with a Type A or E HEPA filter for which performance has been established by one of the following test methods using a thermally generated monodispersed aerosol of dioctylphthalate (DOP) or polyalphaolefins (PAO):*

a) *Institute of Environmental Sciences, IEST RP-CC021.3; or*
b) *U.S. Military Standard, MIL-STD-282.*

6.6.3.3

CAHU filters (including pre-filters and HEPA filters) shall be visually inspected in accordance with the manufacturer's instructions prior to installation and at least daily, and their condition shall be documented. Filters shall be replaced when loaded.

6.6.3.4

CAHUs, their filters, ducting, and accessories shall be operated, maintained, and stored in accordance with the manufacturer's instructions.

6.6.3.5

CAHUs should be selected in accordance with the guidance in Annex F.

6.6.3.6

If a HEPA-filtered vacuum is being used as a CAHU, it shall meet the requirements for CAHUs as specified in this Standard.

6.6.4 Operation, preventive maintenance, and storage of CAHUs

6.6.4.1

CAHUs used for dust mitigation and the maintenance of differential pressures in construction zones shall be performance leak-tested and verified at least every 12 months by a competent third party.

Notes:

1) *The EACO* DOP/PAO Testing Guideline *provides a methodology for testing HEPA filter integrity in CAHUs.*

2) *If a HEPA-filtered vacuum is being used to establish negative pressure on work sites, testing could need to be more frequent. These units can be subject to bumps and falls during transportation and use. The MDT should evaluate the risks and decide whether more frequent testing is needed.*

6.6.4.2

Performance leak tests shall be conducted with HEPA-rated filters in-place and using a non-thermally generated heterogeneous (polydispersed) challenge aerosol, introduced upstream of the HEPA filter and a photometer measuring aerosol penetration downstream of the HEPA filter, in a manner consistent with one of the following standards:

a) IEST RP-CC034.3;
b) NSF/ANSI 49; or
c) ISO 14644-2.

6.6.4.3

CAHUs that will be used in a PM III or PM IV construction project shall be performance leak-tested and verified at the beginning of the project, except as provided in Clause 6.6.4.4.

Note: *This is to confirm that the filter and cabinet will perform as expected, that there is an adequate seal between the filter and mounting frame, and that air flow is within manufacturer specifications with the HEPA filter in place.*

6.6.4.4

If the CAHU has been performance leak tested and the HEPA filter replaced within the past 12 months, and the unit will not be exhausted inside the building, the performance leak testing required in Clause 6.6.4.3 may be replaced by the following process before the CAHU is put into service:

a) replacement of pre-filters and secondary filters;
b) cleaning as follows, without replacing the HEPA filter:
    i) HEPA vacuum all surfaces in and out;
    ii) use compressed air to blow out the fan and motor;
    iii) repeat HEPA vacuuming;
    iv) spray all surfaces, except fan and motor, with approved sporicidal and fungicidal solution, allowing dwell time as per manufacturer's instructions; and
    v) damp wipe all surfaces inside and out, especially wheels; and
c) inspection to confirm that filters will perform as expected, and to ensure there is an adequate seal between the HEPA filter and the mounting frame.

Note: *It is important to ensure that the seals on the HEPA filter are not broken or disturbed during the process. The manufacturer's instructions should be followed.*

6.6.4.5

HEPA filters shall be replaced if any of the following occur:

a) airflow falls below 70% of the manufacturer's specified level;
b) the unit fails a performance leak test; or
c) the filter is visibly damaged.

Note: *Indicator lights on a CAHU do not always show when the filter is loaded. Direct examination is the most reliable way to determine this.*

6.6.4.6

Performance leak testing shall be conducted whenever the HEPA filters are replaced or reseated, and the results shall be documented. Performance leak test verification stickers shall be displayed on the CAHUs and shall include the following information:

a) name and contact information of the company and individual who performed the performance leak-test;
b) date of unit verification in an easily recognizable format;
c) location of unit verification;
d) reported overall minimum unit particulate efficiency; and
e) reported overall minimum unit airflow (CFM) efficiency.

Note: *The date should be easily recognizable using a format that spells out the month and uses complete year (e.g., 02/Mar/2016). Formats such as 02/03/16 are ambiguous and should not be used.*

6.6.4.7

When CAHU's are put into service or relocated during a project, a visual filter inspection shall be conducted by a knowledgeable and competent person. The MDT should be notified of the identity and qualifications of the person doing this work. The inspection results shall be documented by the

constructor responsible for the infection control plan. This inspection shall be thorough enough to identify any significant damage to the filter or the filter-to-frame seal.

Note: *This inspection does not replace the performance leak test requirements in Clauses 6.6.4.1 and 6.6.4.3.*

6.6.4.8

The pre-filter on a CAHU shall be changed on a regular basis as determined by the manufacturer's instructions and the environmental conditions at the work site. In addition, the pre-filter shall be changed if it becomes wet, damaged, or visibly soiled. If the pre-filter is changed on the project site, the change should be performed with the unit running so that dislodged particulate is recaptured by the HEPA filter during the change-out.

Note: *Indicator lights on a CAHU do not always show when the filter is loaded.*

6.6.4.9

A log shall be kept to record the maintenance and storage conditions of CAHUs. The log shall accompany the unit when in service so it can be easily updated and is kept current.

6.6.4.10

Rented CAHUs may be used for projects; however, if they are used, documentation and adequate assurance of the above mentioned preventive maintenance and storage requirements shall be obtained. If a CAHU is brought from a non-HCF site, it shall be refurbished as follows:

a) remove all filters (primary, secondary, and HEPA, except as provided in Clause 6.6.4.11);
b) thoroughly clean the CAHU as follows:
   i) HEPA vacuum all surfaces in and out;
   ii) use compressed air to blow out the fan and motor;
   iii) repeat HEPA vacuuming;
   iv) spray all surfaces, except fan and motor, with approved sporicidal and fungicidal solution, allowing dwell time as per manufacturer's instructions; and
   v) damp wipe all surfaces inside and out, especially the wheels; and
c) reassemble with new HEPA filter and re-verify (except as provided in Clause 6.6.4.11).

Notes:

1) *These activities should be performed on the project site.*

2) *It is understood that there is a break in the chain of custody in controlling what contaminants CAHUs are exposed to when rented. This requirement is intended to address possible exposures of the CAHU to hazardous substances such as mould spores and hyphal fragments, lead dust, asbestos fibres, etc., prior to its use in an HCF.*

6.6.4.11

If the rental company is greater than 250 km from a qualified tester, and the CAHU has been tested and the HEPA filter replaced within the past 12 months, all strip down and cleaning procedures shall be performed without replacing the HEPA filter, as specified in Clause 6.6.4.4.

Rental units shall be verified by the rental company to have been thoroughly cleaned and tested prior to being sent to a new site.

6.6.4.12

Storage and maintenance of CAHUs shall only take place in Population Risk Group 1 areas or outside of the HCF. Maintenance shall be performed in locations and at times when such activities will not contaminate other systems or equipment. Maintenance of the units may be conducted in Population Risk Group 2, 3, and 4 areas only when all preventive measures are in-place and operational.

6.6.4.13

The storage location of CAHUs, their filters, ducting, and accessories shall be safe and secured to avoid unauthorized use, physical damage, and water damage. The storage area shall have a controlled climate consistent with ANSI/ASHRAE 55. Temperature shall range between 20 to 28 °C and relative humidity shall range between 30 to 60% to provide an environment that will not readily promote mould growth on filter media and equipment. All materials should be stored off the floor to protect them from spills, flooding, and dampness. Materials and equipment shall be stored in a way that promotes air circulation and drying.

6.6.4.14

CAHUs, filters, ducting, and accessories may be stored under cover or in bags to protect from dust accumulation. Care shall be taken to ensure that covers and bags do not trap moisture, as this could promote the growth of mould. Filters shall be stored in a way that does not trap moisture.

6.6.5 Movement of CAHUs

6.6.5.1

CAHUs shall be thoroughly inspected before leaving storage and upon arrival at the work area to ensure

a) they are operating in accordance with the manufacturer's specifications and recommendations;
b) they are in good working order;
c) they are thoroughly clean and free from dust, dirt, soil, debris, residue, moisture, and biological contamination;
d) that all the filters (including HEPA filters) are in place; and
e) the unit(s) has been performance leak tested in accordance with Clause 6.6.4.

6.6.5.2

After use, the CAHU shall be surface cleaned and contained as follows before being moved from a construction site:

a) all surfaces shall be thoroughly cleaned using a HEPA-filtered vacuum or damp wiping; and
b) the unit intake and exhaust openings shall be covered with polyethylene and tape sealed to prevent dust from being dislodged during transport through the HCF or from site to site.

Polyethylene covers shall be removed from the intake and the exhaust openings after transportation and before storage. The unit shall not be stored with the polyethylene covers in-place nor shall the covers be left in-place for more than 8 h, as this can trap moisture and promote mould growth.

6.6.5.3

Pre-filters shall be removed, bagged, and sealed at the maintenance area.

6.6.5.4

CAHUs shall be protected during transportation in accordance with the manufacturer's instructions and recommendations. If the movement of a CAHU could disrupt the seal between the HEPA filter and its frame, the unit should be performance leak tested and re-verified prior to use. If the unit will be discharged into the building, the performance leak testing should be performed in situ prior to use.

CAHUs that will be used in a PM III or PM IV construction project shall be performance leak tested before the project start in accordance with Clause 6.6.4.3.

Note: *Disruption of the seal could occur as a result of vibration, agitation, travel over rough terrain, shifting, loading, or impact.*

6.6.6 Air sampling and monitoring

6.6.6.1

Air sampling (particularly for biological agents) is not recommended as a primary or routine means of infection control monitoring of construction, renovation, or repair projects. Monitoring of air quality for a limited time can be useful in specific situations (see Clause 6.6.6.2); however, its purpose and use should be carefully considered prior to implementation.

6.6.6.2

Air sampling may be considered by the MDT to

a) monitor a patient care area near a construction zone, where there is a high-risk patient population that could be adversely affected by airborne contaminants;
b) evaluate the efficacy of changes to preventive measures and procedures;
c) assess the quality, effectiveness, and maintenance of the environmental barriers installed and the containment methods, equipment, and practices used to control the generation and transmission of dust and aerosols;
d) commission new or renovated space intended for high-risk patients to ascertain that the space is acceptable for occupancy; or
e) identify potential problems with the outside air that will be brought into the building through construction heaters or ventilation systems, especially in new construction projects.

Note: *In interior areas that are completed by the constructor and sealed to restrict access by construction staff, air sampling can be done to verify that the external air has not adversely affected air quality.*

6.6.6.3

Air sampling should be considered only after all other preventive measures have been implemented. If air sampling is to be conducted for any purpose on the project, the MDT shall prepare a written program that establishes

a) the agents to be sampled for and, in the case of airborne dust, the particulate size fraction(s) to be sampled;
b) acceptable airborne concentrations of the agents of interest;
c) the instrument(s) and the sampling and analytical method(s) to be used, including the volumes to be taken and the detection limits;
d) concentrations that require action, and the appropriate and corresponding action(s) to be taken and by whom;
e) the duration and frequency of sampling; and
f) a quality assurance and quality control program for the sampling, analysis, and interpretation.

Notes:

1) *Pre-construction sampling can provide baseline levels that can be compared against levels from sampling during and after construction. Care should be taken to account for the significant seasonal, geographical, and environmental variations of biological air samples when comparing them to the pre-construction baseline.*
2) *Air monitoring provides only a snapshot of the conditions at the time of sampling. Obtaining precise, accurate, and meaningful air samples of viable micro-organisms (including pathogenic mould and bacteria) is a complex and difficult process. Lack of biological growth on cultured samples does not necessarily indicate that the environment is free of biological contaminants or pathogenic mould and bacteria, and does not guarantee a risk-free condition or work practice.*
3) *Biological air sampling (regardless of the attainment of favourable results) does not negate the requirement to conform to this Standard and the prescribed preventive measures and procedures.*
4) *Air monitoring (particularly for airborne particulate) can be effective for providing prompt or real-time data to assess the efficacy of implemented preventive measures and procedures.*
5) *The air monitoring program should be both realistic and cost effective for its intended purpose.*

6.6.6.4

Formal air sampling, if done, should be performed by qualified HCF personnel or by a qualified consultant. Sampling results shall be documented.

Note: *Documentation allows the facility to accumulate data over time, which is essential for comparison and the tracking of trends.*

6.6.6.5

HCF personnel who perform formal air sampling should

a) hold valid certification in the industrial or occupational hygiene field; or

b) be able to demonstrate they have been adequately trained in sample collection and interpretation.

Note: *Qualification of personnel should be documented though a formal certification program under a recognized organization.*

6.6.6.6

Outside consultants or testing firms shall have formal, demonstrated qualifications.

Note: *Examples of qualifications include the following:*

a) *Canadian qualifications, such as*
   i) *Registered occupational hygienist (ROH);*
   ii) *Registered occupational hygiene technologist (ROHT); or*
   iii) *Canadian registered safety professional (CRSP); or*

b) *American qualifications, such as*
   i) *Certified industrial hygienist (CIH); and*
   ii) *Certified safety professional (CSP).*

6.6.6.7

Informal reference sampling may be done by HCF staff who have been designated by the MDT, for the purposes of determining air quality in areas where patients in Population Risk Group 3 or 4 are located, particularly where these areas are adjacent to renovation or construction. There shall be procedures for investigation and follow-up by qualified personnel (see Clauses 6.6.6.5 and 6.6.6.6) in the event that these routine samples exceed the baseline or established action levels.

6.6.6.8

If air sampling is done, the total particulate, fungal spore concentrations, mould genera and species measured in the construction area after construction and in the patient care areas during or after construction should be comparable with pre-construction or comparative area concentrations unaffected by construction or mould.

6.7 Water quality

6.7.1

The quality, distribution, and use pattern associated with the HCF's source water should be identified and high-risk areas highlighted. The plumbing system design and implementation, including the treatment of completed systems, shall be in accordance with CSA Z317.1.

6.7.2

Appropriate methods shall be used to ensure water potability and quality during HCF construction, renovation, and repairs, including those specified in Clauses 6.7.3 to 6.7.13.

6.7.3

Plumbing materials used in the HCF's water systems shall be resistant to the build-up of scale and corrosion, and shall not promote the growth of bacteria.

6.7.4

Features conducive to stagnation (e.g., long pipe runs and dead ends) shall be minimized in the design of HCF plumbing systems. Faucet aerators shall

a) not be used on new faucets;
b) not be reinstalled on any sinks in the construction zone or impacted by the renovation; and
c) be removed from other existing faucets.

Notes:

1) *The intent of this Clause is to ensure there will be no aerators left on faucets in renovated areas.*

2) *CSA Z317.1 provides additional requirements and guidance on plumbing system design to prevent the growth of infectious micro-organisms.*

6.7.5

The temperature of the water provided by hot water outlets shall meet the requirements of CSA Z317.1.

6.7.6

Dead leg pipes that are created as a result of a construction project shall be removed as close to the main line as possible. The constructor shall determine what worker protection, if any, is required for removal of the dead leg pipe.

Note: *A bleed line might be needed to drain and disinfect a dead leg pipe before removal. The factors for determining whether such drainage is necessary are the temperature, age, and location of the pipe, as well as any history of contamination, the duration of stagnation, and the material of which the pipe is made.*

Where it is impractical to remove dead leg pipe, it shall be isolated from the live plumbing system, drained of water, and permanently capped. A tag identifying that the line has been isolated and the date of isolation shall be affixed to each end where the line has been isolated.

6.7.7

Intact water systems that have been shut down for construction shall be flushed at least monthly. However, flushing of the system should be done at two-week intervals.

Notes:

1) *Moist environments and water systems can serve as growth sites for opportunistic pathogenic micro-organisms. In addition to micro-organisms usually present in distribution system piping, any breach of water system integrity, whether deliberate or accidental, can introduce micro-organisms that are ubiquitous in soil and other environments into the water systems, where they can remain and amplify. Accidental incursions into water pipes can occur during transient pressure changes during construction. Stationary or low-flow areas are frequently found to contain higher numbers and concentrations of pathogens such as* legionellae*. The modes of transmission of micro-organisms from water to humans include direct contact, ingestion, indirect contact, inhalation of aerosols, and aspiration of contaminated water.*

2) *Major construction disturbances can create water quality problems at any place in an interconnected system throughout a HCF. Several locations in HCFs are particularly vulnerable because of the way they use water, e. g., endoscope washing and dialysis units (which require high-quality filtered water). During construction, there can be disturbances in the water system that necessitate changing water filters more often and with greater care.*

6.7.8

Water lines shall be flushed to clean pipes and remove debris after new plumbing has been installed and before occupancy by patients. Flushing of the plumbing system shall include the flushing of each distal site for a minimum of 10 min. In situations where the constructor has flushed the plumbing system as part of their work before substantial completion of the contract, and considerable time has subsequently passed during the occupancy process by the HCF (e.g., for staff training, equipment coordination, and terminal cleaning), the project manager or facilities department staff shall implement a program to ensure that the plumbing system does not become stagnant and is routinely flushed at least twice weekly with not more than 3.5 days between flushing. The plumbing system shall be flushed again prior to patient occupancy.

Notes:

1) *The necessary flushing times can vary depending on a number of factors, including*
- a) *line size;*
- b) *flow rate;*
- c) *pressure;*
- d) *length of pipe;*
- e) *number of dead ends;*
- f) *age of the system; and*
- g) *history of contamination.*

2) *CSA Z317.1 provides additional requirements and guidance on flushing of plumbing systems.*

6.7.9

Any appearance of discolored water shall be immediately reported to HCF operation and maintenance staff and infection prevention and control personnel.

6.7.10

For new or significantly altered systems, or following the reactivation of a plumbing system that has been inactive (i.e., stagnant) or that was drained down for an extended period, the potable water system shall be treated immediately prior to occupancy with hyperchlorination using the method specified in Clause 6.8.

6.7.11

Surveillance for *Legionella* or other waterborne micro-organisms shall be undertaken before, during, and after construction if a clinical need has been established by the infection prevention and control department.

Note: *Surveillance is an active process that includes monitoring of environmental conditions, monitoring of infections, identification of potential problems, and following up to resolve infection control issues.*

6.7.12

Following excavations on HCF grounds where buried potable water plumbing systems are disturbed or where soil could enter the plumbing system, or when the plumbing system has been shut down and then repressurized, the water supply shall be cultured for *Legionella*. The HCF shall perform a risk assessment to determine the appropriate action between the time of testing and when it receives the results. Based on the risk assessment, the HCF shall implement appropriate measure to protect patients.

Notes:

1) *The risk assessment should include consideration of at least the following factors:*
- a) *water source;*
- b) *extent of the work;*
- c) *HCF areas and population risk groups served by the system;*

d) *uses of the water; and*
e) *presence of other systems to manage water quality (e.g., filters, copper/silver ionization).*

2) *Following the risk assessment, appropriate actions may include*
a) *turning the water on immediately;*
b) *installing point of use filtration or taking other precautions before using; or*
c) *not using the system at all until a successful result is received.*

6.7.13

A regular program of preventive plumbing system maintenance shall be followed.

Note: *See also CSA Z317.1.*

6.8 Water system disinfection

6.8.1

Following construction and prior to occupancy, water systems shall be disinfected using hyperchlorination and then tested in accordance with CSA Z317.1.

Notes:

1) *Hyperchlorination of potable water systems for purposes other than post-construction disinfection should only be undertaken if there is a serious concern for patient safety on the part of the infection prevention and control department and the site MDT. This process can present significant risks and limitations associated with their implementation, and its use should be carefully evaluated by the MDT.*

2) *CSA Z317.1 specifies hyperchlorination as the preferred method for system disinfection; however, it includes information and guidance on superheating, for situations where that method is needed.*

6.8.2

The HCF shall document its activities with respect to water system treatments, including the evaluation process, one-time and ongoing treatments, and follow-up.

6.8.3

When hyperchlorination is used, staff and patients shall be alerted and measures shall be taken to prevent the use of the plumbing system during this treatment. After the plumbing system has been hyperchlorinated, the entire treated plumbing system shall be flushed to bring the chlorine concentrations to background and then tested in accordance with CSA Z317.1, before precautions removed for use of the system. The date, time, and results of the hyperchlorinization process shall be documented.

Note: *Hyperchlorinating the entire potable water system or the domestic hot water system in a HCF can be an effective treatment to disinfect an affected or stagnant plumbing system or discourage the growth of* Legionella *bacteria or other waterborne pathogens. The HCF should be aware that frequent or excessive use of chlorine can cause accelerated corrosion and premature leaking of the plumbing system.*
The following factors should be analyzed before this treatment is conducted:

a) *age of facility piping infrastructure;*
b) *amount of scale and sediment in the plumbing system (as it may decrease efficacy);*
c) *age and number of renovations in the affected area or facility since the original construction;*
d) *number of potential dead legs in the piping system;*
e) *volume of water in the entire plumbing system;*
f) *time and concentration requirements for treatment to be effective;*
g) *delivery method used to introduce the chlorine into the system;*
h) *availability of means to confirm that the appropriate target concentration and dwell time of chlorine in every part of the system has been achieved; and*
i) *the potential for accelerated corrosion and premature leaking of the plumbing system.*

6.8.4

If facility systems and conditions warrant it, a secondary disinfection system (e.g., a copper-silver ionization) may be installed on hot water recirculating lines to discourage growth of *Legionella* or other waterborne pathogens.

Notes:

1) *Such treatment systems are especially valuable for health care facilities with significant risk factors including very large buildings with complex piping systems, older facilities that have undergone multiple renovations or have a considerable number of existing dead leg pipes, or health care facilities that are responsible to deliver their own water supply (well systems).*

2) *The following factors should be considered in the evaluation to determine whether a secondary disinfection system is warranted, and if so, the type of system that should be used:*

a) *age of facility piping infrastructure;*
b) *amount of scale and sediment in the plumbing system (as it may decrease efficacy);*
c) *age and number of renovations in the affected area or facility since the original construction;*
d) *number of potential dead legs in the piping system;*
e) *volume of water in the entire plumbing system;*
f) *time and concentration requirements for treatment to be effective;*
g) *the capacity of the system used to introduce the secondary disinfection into the system;*
h) *concentration requirements for water treatment to be effective;*
i) *existing water chemistry and its potential effects on the system; and*
j) *availability of a means to confirm that the appropriate target concentrations in each and every part of the system has been achieved and the ability to maintain the system on a long-term basis in optimum condition.*

The evaluation should also consider current research on the efficacy of each secondary disinfection technology, and potential long-term effects on patients and staff from the use of the technology (e.g., elevated concentration of minerals from a copper-silver ionization system).

6.9 Constructor's request for service shutdowns and for activities presenting specific hazards

6.9.1

The HCF shall develop a formal documented process, with appropriate approvals, to manage requests for shutdown and requests to perform activities that can produce or disturb especially hazardous materials (e.g., asbestos). This process shall be included in the project requirements and building leases and shall include mechanisms for review, response, and recording of requests for shutdowns, start-ups, or hazardous materials removal.

6.9.2

The HCF's procedures shall include the steps to be taken when an emergency request is received, including an assessment of the urgency of the work, the potential risks of the work, and the necessary approvals to proceed.

6.9.3

All requests for major shutdowns that could affect the safety of high-risk patients or major portions of an HCF shall be communicated to the MDT. The documented shutdown process shall state the types of shutdown and the hazardous materials work that require MDT input and approval. Requests for shutdown shall also be communicated to other relevant staff and administrators in accordance with the HCF's procedures for shutdowns.

6.9.4

The constructor shall submit a request in writing to the HCF project manager or owner's representative for work that will require shutdowns associated with the following functions:

a) steam systems;
b) medical gases, including medical air;
c) compressed air systems;
d) sprinkler systems;
e) domestic hot or cold water supply, control, storage, treatment, circulation, and piping systems;
f) heating or cooling water systems;
g) electrical systems (e.g., zone shutdowns), emergency power systems, and electrical equipment;
h) HVAC systems or equipment;
i) building automation systems (BAS);
j) liquid waste and drainage systems;
k) general or specific exhaust systems, including scavenging systems; and
l) communication systems.

Note: *If an organization other than the HCF is the contract holder for a construction project (e.g., a provincial/ territorial infrastructure agency), that organization would provide documentation to the HCF sufficient to demonstrate compliance with this Clause.*

6.9.5

In addition, the constructor shall submit a request in writing to the HCF project manager or owner's representative for work that will present specific hazards that require additional precautions.

These include

a) asbestos removal;
b) mould removal; and
c) cutting or coring of concrete slab.

Note: *These activities can generate dangerous conditions that could disturb hazardous materials. They require specialized equipment and techniques and a specific dust management plan.*

6.9.6

Except in emergency situations, the written requests for shutdown and for work that presents specific hazards shall be submitted in advance of the planned commencement of the work in accordance with the policies of the HCF. The HCF should provide a response, within the time stipulated by its policies, by signing and dating the constructor's request.

Note: *The request for shutdown form is for the use of individuals and organizations directly involved with the HCF and the construction project. It does not replace hazardous material removal plans or other forms that could be required by authorities having jurisdiction.*

6.10 Excavation, demolition, or significant construction in proximity to the HCF

6.10.1 General

The HCF shall develop and implement appropriate preventive measures when construction is planned or taking place in proximity to the HCF, but outside of its control. If the work involves excavation, building demolition, or significant construction, the HCF shall perform an ICRA for the excavation, demolition, or construction activities and shall implement the appropriate preventive measures.

Where the HCF is impacted by significant demolition, excavation, or construction adjacent to its property and this work is not under the control of the HCF, the site MDT shall identify itself to the

adjacent property owner before work begins to put in place a risk management plan with that owner for the protection of patients and staff at the HCF.

Notes:

1) *Excavation, demolition, or significant construction near an HCF can present significant risks to patients and staff. The HCF should establish a working relationship with municipal planning authorities to ensure it is kept aware of planned construction in its area.*

2) *Major projects in proximity to the HCF that are under the HCF's control are already covered by the provisions of this Standard.*

6.10.2 Risk assessment

The ICRA for projects taking place near the HCF shall include consideration of

a) the scope of the project;

b) the at-risk populations and their locations within the HCF;

c) the types of patient procedures occurring at the HCF and risks related to critical, semi-critical, or non-invasive procedures;

Note: *The route of transmission (e.g., inhalation or contamination by fomites) to the patient/client or resident will have impact based on the level of risk of the procedure performed.*

d) proximity of the construction activity in relation to the patient care areas in the HCF. This includes identification of HCF openings and incursion points such as air intakes, doors (including bay doors, loading doors), windows, exits, and utility connections;

Notes:

1) *Other factors that could impact the HCF include, but are not limited to,*

a) *distances from construction operations to the existing HCF and its identified openings;*
b) *impact of wind direction(s);*
c) *cleanliness of HVAC systems and its filters;*
d) *types of excavation or demolition operations;*
e) *seasonal impacts (i.e., rain, snow etc.); and*
f) *operation of construction machinery and equipment (e.g., trucks, mobile equipment) nearby the HCF and on its access roads.*

2) *The HCF might need to redirect traffic patterns for patients, staff, and supplies to minimize exposure to dust and other hazards associated with the neighboring construction site.*

e) if a demolition, the method that will be used (e.g., implosion /explosion or wrecking ball);

Note: *A wrecking ball creates less dust than implosion/explosion.*

f) air intakes located close to the activity and what system is in place (e.g., recirculating or fresh air systems);

g) the type of air filters that are in place and their efficacy;

Note: *It is important to know what filters are in place and determine whether additional filters are needed before and after the fan. Filter change frequency will have to be determined, as well as establishing a monitoring of the pressure differential of the filters during the demolition and construction activity.*

h) the air pressure of the building related to the outside environment and the possible effect of elevators located near entry doors;

Note: *If the elevators have dedicated exhaust systems, contaminants will be removed from the facility. If this is not the case, measures should be taken to minimize the entrainment of dust at entries due to the movement of elevators.*

i) potential effects on water supply and other utilities; and

j) prevailing wind direction.

Note: *This is important to determine the likely direction dust and debris will travel so that adjacent open spaces (e.g., outside seating areas) can be closed or protected.*

If a construction project is taking place in the proximity of other buildings on a HCF campus, the HCF shall conduct risk assessments for each of the adjacent buildings where health care services are provided.

6.10.3 Prevention and control strategies

6.10.3.1

The HCF shall make the necessary adjustments to ensure that dust from adjacent construction is not drawn into its HVAC system. See Clause 7.3.3.3. If there is a possibility that demolition or construction in proximity to the HCF will affect an area with high-risk patients, the HCF should institute monitoring as follows:

a) Baseline air sampling including total spores and *Aspergillus*. Monitoring should include sampling at control locations outdoors near the construction activity and indoors in the high-risk patient location for comparison.
b) Frequency of sampling should be determined by the type and increase in construction activity and if patients are more at risk. Sampling should take place before, during, and after construction.

Results shall be interpreted by qualified environmental personnel.

6.10.3.2

To the extent possible, the HCF should inspect the worksite or communicate with worksite managers to confirm that

a) dust containment barriers at the source are appropriate;
b) soil, rubble, and debris are kept moist to prevent migration;
c) doors, windows, and entries are closed, barred from use, and sealed as appropriate;
d) workers from the site implement hygienic measures to prevent dust and debris from being carried into the HCF; and
e) waste is being kept to a minimum.

6.10.3.3

The HCF should protect entrances where dust is likely to enter or else limit their use.

Note: *Surrounding the entry with an enclosure and directing the opening away from the demolition can help to reduce dust.*

6.10.3.4

The following additional precautions shall be taken:

a) Continual wetting down of the demolition site shall be conducted to prevent the spread of dust to nearby buildings occupied by patients.
b) Trucks carrying demolition materials shall be covered, and they shall be routed as much as possible to avoid buildings occupied by patients and to minimize disruption to the HCF.

6.10.4 Contingency planning

Contingency plans should be developed and maintained to address potential accidents that could raise risk levels, e.g., due to dust or contaminated water entering the HCF. The HCF emergency response plan shall be reviewed to incorporate any code situations.

Note: *The requirements in this Clause have been adapted from Cheng and Streifel (2001).*

7 Infection prevention and control measures for renovation, repairs, and maintenance

7.1 General

This Clause outlines required infection prevention and control measures based on the population risk group and type of construction activity. See Table 1 for a summary of the information presented in this Clause.

These measures are intended to prevent contamination of spaces that are being used or will be used for patient care. Moving patients away from areas affected by construction can be used in some cases for partial protection, but it does not preclude the use of the preventive measures that are specified in this Clause.

Note: *See Clause 8 for requirements relating to new construction.*

7.2 Before construction

7.2.1 General

7.2.1.1

Before construction begins, the site MDT (see Clause 6.2.1) shall determine where infection prevention and control measures are necessary and complete a preventive measures analysis form. A copy of this form shall be kept by the HCF and may be included in project process or tender documents. The MDT shall be involved in the planning during schematic and design phases.

Note: *See Annex C for a sample preventive measures analysis form.*

7.2.1.2

Renovation projects (other than minor refurbishing and cosmetic upgrades) shall be evaluated to determine whether or not they constitute new construction. The renovation should be treated as Category 2 or Category 3 new construction (depending on the connection to the existing facility) if any of the following apply:

a) the project changes the function of the renovated area (e.g., converting office space into clinical areas);
b) life safety systems will be replaced; or
c) the building exterior will be substantially changed.

The MDT shall be responsible for the final decision as to whether a renovation is to be treated as new construction.

7.2.2 Preventive measure I

7.2.2.1

The HCF project manager or the constructor shall identify essential services (e.g., water supply, electricity, and ventilation systems) that could be disrupted, and appropriate measures that the HCF will need to take to approve system shutdowns (see Clause 6.9) and, if applicable, to address the disruption. This information shall be communicated to health care staff responsible for the patients who could be affected by the disruption.

Note: *In some cases it might be necessary to provide alternative water sources for occupant use if the domestic water supply is disrupted.*

7.2.2.2

The health care staff shall work with infection prevention and control personnel to identify high-risk patients who might need to be temporarily moved away from the construction area to minimize their exposure to hazardous conditions. For example, patients who are immunosuppressed or otherwise vulnerable should be moved away from the construction area before construction begins unless it can be ensured that air quality can be maintained at safe levels during construction.

7.2.3 Preventive measure II

7.2.3.1

In addition to following PM I, the site MDT, in conjunction with the HCF project manager, shall

a) determine a safe route for the transportation of clean or sterile supplies and equipment away from the construction area;
b) establish traffic patterns for construction workers that avoid patient care areas;
c) minimize exhaust output from elevators that serve construction areas to ensure that construction dust is not recirculated into the HCF (e.g., by turning off or filtering cab ventilation fans);
d) if practical, designate an elevator for use exclusively by construction workers; and
e) confirm water temperature standards for the HCF.

Note: *CSA Z317.1 includes additional requirements regarding hot water temperatures.*

If patient care areas cannot be practically avoided, the constructor shall, at the minimum, reduce potential adverse impacts on those patient care areas by developing alternate traffic patterns and routes for construction workers.

7.2.3.2

The HCF project manager or the constructor shall ensure that the project plan identifies whether domestic cold, hot, and recirculation water lines will be affected by the construction. The project plan shall include

a) identifying plumbing lines that will need to be
   i) shut off or interrupted using existing valves; or
   ii) isolated by additional valves;
b) determining the method to be used to disinfect the water lines before occupancy;
c) drafting the procedure to be used to disinfect the water system, including identifying the required equipment; and
d) if applicable, determining the flow path to be used to hyperchlorinate and flush water lines affected by the construction.

7.2.3.3

Infection prevention and control personnel shall ensure that an effective surveillance system is in place to monitor patients for *Legionella* in the event that

a) soil excavation takes place on, or in proximity to, HCF grounds; or
b) the water supply has been disrupted and then repressurized.

7.2.3.4

Drawings shall be obtained that show the layout of the ventilation systems that supply air to, or exhaust air from, the work area. The project plan shall state whether it is necessary to close outlets, modify performance, shut down systems, or make other changes to the HVAC system. When reliable drawings

or control programming are not available, the site service systems shall be surveyed to confirm or provide reliable planning information.

7.2.4 Preventive measure III

7.2.4.1
PM I and II shall be followed.

7.2.4.2
The MDT shall meet to determine appropriate infection prevention measures in accordance with Table 1. See Clause 7.2.1

7.2.5 Preventive measure IV
PM I, II, and III shall be followed.

7.3 During construction

7.3.1 Preventive measure I

7.3.1.1
Constructors (including staff performing operation and maintenance activities) shall be responsible for dust control, and shall use methods that minimize the generation and dispersion of dust during and after construction. Immediately after the construction activity (e.g., visual inspection) has been completed, the constructor shall close access panels and replace displaced tiles and, if necessary, clean the work area with a HEPA-filtered vacuum cleaner.

Note: *Constructors include operation and maintenance staff when engaged in related activities.*

7.3.1.2
Operation and maintenance staff or constructors performing plumbing work shall

a) use gasket material that is smooth and does not promote buildup of biofilm and scale;
b) replace gaskets if worn or rough;
c) ensure that faucet aerators are not installed or used (see Clause 6.7.4);
d) maintain a dry work environment; and
e) schedule water interruptions in advance and receive approval before starting.

Note: *CSA Z317.1 includes additional requirements for plumbing system design.*

7.3.1.3
Work should be performed during periods of low user activity (e.g., evenings).

7.3.1.4
Shipping, handling, and storage of construction materials shall be in accordance with Clause 5.3.

7.3.1.5
Environmental services and health care staff shall

a) immediately report discoloured water and water leaks to the HCF's operation and maintenance staff and infection prevention and control personnel; and
b) ensure that patient care equipment and supplies are protected from dust exposure.

7.3.2 Preventive measure II

7.3.2.1 General

In addition to following PM I, the requirements specified in Clauses 7.3.2.2 to 7.3.2.5 shall be met.

7.3.2.2 Methods to minimize dust generation and migration

Constructors shall execute their work using methods that minimize dust generation and migration into the atmosphere. Examples of such methods include

a) using drop sheets to control dust;
b) polyethylene sheeting that reaches from the floor to the ceiling, with the top, bottom, and side edges sealed off to isolate the construction area from adjacent areas;
c) controlling dust by water-misting work surfaces while cutting (using appropriate electrical safety measures);

   Note: *Caution should be exercised when such techniques are used on cellulose or fibre-based materials that are intended to stay in place following construction work.*
d) sealing windows and unused doors;

   Note: *Fire codes and other regulatory requirements can apply to the sealing of a building exit.*
e) sealing plumbing penetrations, electrical outlets, and any other sources of potential air leaks in the construction area;
f) sealing air supply and return ducts in the construction area;
g) placing a walk-off mat outside the entrance to the construction area to trap dust from the equipment and footwear of personnel leaving the area, and selecting and maintaining the mat as specified in Clause 6.6.1.9; and
h) incorporating dust capturing attachments to the hose of the HEPA vacuum.

Note: *Annex E provides examples of barrier configurations. See Figures E.1, E.2, and E.6.*

7.3.2.3 Building ventilation systems

7.3.2.3.1

Operation and maintenance staff or constructors shall take special precautions related to the ventilation system in the construction area. If possible, the ventilation system should be disabled until the project has been completed.

Note: *In some circumstances, the permanent ventilation system may be used to exhaust air from the construction site. See Clauses 7.3.3.3.5 and 7.3.3.6.2.*

7.3.2.3.2

If the ventilation system cannot be disabled, an engineering analysis shall be performed to ensure that the fan systems are performing as intended to maintain relative pressurization and exhaust contaminated air, and that the operation of the HVAC system is not compromised.

7.3.2.4 Plumbing

Operation and maintenance staff or constructors performing plumbing work shall

a) avoid using collection tanks and long pipes (which allow water to stagnate);
b) maintain a dry work environment and report any water leaks through walls or substructures;
c) disinfect domestic water systems or sections of systems that have been stagnant (especially if *Legionella* is suspected or known to be present in the domestic water supply) in accordance with Clause 6.8; and

d) be aware of the impact of techniques to remove bacterial growth and choose the approach that minimizes the risks associated with such work.

The water lines in the construction area and adjacent patient care areas shall be flushed before reuse. See Clauses 6.7 and 6.8.

Note: *Preventive technologies (e.g., silver-copper ion treatments) may be used in place of the techniques specified in Item c).*

7.3.2.5 Site maintenance

7.3.2.5.1

Operation and maintenance staff or constructors in the construction area shall

a) periodically clean the construction area with a HEPA filter-equipped vacuum cleaner or a wet mop, or both, as necessary;
b) place debris in covered containers or cover it with a moistened sheet before transporting it for disposal;
c) place supplies and equipment in covered containers during transportation through the HCF to prevent contamination in other areas;
d) wipe the wheels of mobile equipment, transport carts, and bins before entering occupied areas; and

   Note: *Walk-off mats are not sufficient as a static measure to remove wheel dust.*

e) inform facility environmental services if there is cleanup to be done outside of construction area.

7.3.2.5.2

Debris shall be removed in the evening when patients are in their rooms and visitors have left, if possible. If this is not possible, debris should be removed at the end of the workday. Exposure of the occupants of the HCF to debris shall be minimized.

7.3.3 Preventive measure III

Note: *See Figures E.3, E.5, and E.6.*

7.3.3.1 General

In addition to following PM I and II, the requirements specified in Clauses 7.3.3.2 to 7.3.3.9 shall be met.

7.3.3.2 Minimization of dust generation and dispersal

7.3.3.2.1

Constructors shall

a) erect an impermeable dust barrier, from the floor to the underside of the deck (including the areas above false ceilings) consisting of two layers of 6 mil polyethylene (or an equivalent barrier accepted by the MDT) and a gypsum wallboard protective layer. The polyethylene membrane shall be present under all circumstances to maintain the required pressurization (see Clause 6.6.1). Fire retardant polyethylene shall be used for exposed surfaces. The surface closest to the hospital zone shall be wipeable. The dust barrier shall remain in place until the project is complete and the area has been thoroughly cleaned and inspected. After construction has been completed, the dust

barrier shall be removed to minimize the spread of dust and other debris particles adhering to the barrier;

Notes:

1) *The two layers of polyethylene are intended to help maintain pressure differentials between the construction area and adjacent areas.*

2) *The protective layer should be of a material that does not produce dust.*

3) *Removal of the dust barrier may be performed by*

a) *vacuuming surfaces with a HEPA-filtered vacuum;*

b) *taking down the barrier and cleaning it again by vacuuming (if practicable) and damp wiping surfaces; and*

c) *rolling up the polyethylene (construction side in) to contain the dust.*

b) use impermeable temporary containment units (vessels) constructed to contain dust and other contaminants. Such containment units shall have a monolithic (one-piece) exterior shell constructed of a minimum of 8 mil fibre-reinforced, fire-retardant polyethylene (or an equivalent barrier). The construction of the containment unit shall allow for containment of contaminants within the vessel and have ports through which HEPA-filtered vacuum cleaners or CAHUs can be easily attached to draw the unit under negative pressure; and

c) HEPA vacuum mechanical and electrical systems and spaces above drop or false ceilings, if necessary.

Notes:

1) *Barrier walls can have an impact on fire or life safety systems. The authority having jurisdiction should be consulted regarding requirements for barrier construction.*

2) *A wipeable surface would include any smooth surface (e.g., vinyl veneer, painted surface, or smooth plastic product) that can be easily cleaned using hospital grade cleaning products.*

7.3.3.2.2

Where deemed appropriate by the MDT, the composition of the dust barrier or containment unit referenced in Item a) or b) of Clause 7.3.3.2.1 may be modified to suit time, space, or impact constraints.

7.3.3.2.3

Measures shall be used to ensure that contaminants from the construction site are not transferred to patient care areas on workers' clothing.

Notes:

1) *Workers should be routed away from patient care areas wherever possible.*

2) *If workers have to pass through patient care areas, this requirement could be met by having them wear protective clothing while in the construction site and remove it immediately upon leaving the construction zone and before entering patient care areas.*

3) *If this is impractical, as an acceptable alternative, workers may don protective clothing before entering patient care areas.*

7.3.3.3 Ventilation

7.3.3.3.1

Operation and maintenance staff or constructors shall

a) disable the HCF's permanent ventilation system and seal duct openings in the construction area until the project is completed;

b) maintain negative pressure within the construction area (see Clause 7.3.3.3.2);

c) periodically check the condition of CAHU filters and replace them if they are wet, damaged, clogged, or functioning below the manufacturer's specifications;

d) ensure that the air is exhausted directly outside and away from intake vents and filtered through a HEPA filter (see Clause 7.3.3.6.3); and
e) ensure that the HCF's permanent ventilation system is functioning properly after the construction project is complete and is cleaned before restarting if contaminated by soil or dust.

7.3.3.3.2

The constructor shall continually monitor the pressure differential between the construction zone and occupied areas by means of a pressure differential monitoring device connected to a local alarm. The monitoring device shall be no closer than 5 m of the entrance to the construction site and be located on the adjacent or exterior side of the dust barrier. This distance may be reduced if the configuration of the site does not permit a 5 m separation. The local alarm shall be of an audible or visible type that can be heard or seen in the vicinity of the alarm, and the system shall be active at all times. Monitoring equipment shall be maintained and zeroed and calibrated in accordance with the manufacturer's instructions.

Note: *If continuous surveillance of the system is needed, this may be accomplished through the use of automatic dialers, a centrally monitored alarm panel, or other automated communications systems.*

7.3.3.3.3

The pressure differential monitoring device should be connected to a permanently mounted data recorder.

The constructor shall record in a log sheet on a daily basis the pressure differential from the monitoring device. If the pressure differential is less than 7.5 Pa of negative pressure within the construction zone for more than 4 h, or if it drops to less than 2.5 Pa for more than 90 s, the constructor shall take immediate corrective measures to restore and maintain the required pressure differential.

7.3.3.3.4

Air may be recirculated in accordance with Clauses 6.6.1.7 and 7.3.3.6 in the following situations:

a) minor repairs of less than 10 min duration (e.g., changing a light bulb); and

   Note: *The use of this option depends on risk assessment by qualified staff and is based on factors such as the criticality of the space, potential for dust generation of the work, age of the facility, and the expected cleanliness of the ceiling space.*

b) work in spaces where conditions prohibit directing exhaust outside.

For ceiling access guidelines for investigation and minor work see Clause 7.5.

7.3.3.3.5

The permanent air handling system may be used for exhausting air from the construction zone only under the following conditions:

a) the air handling system is an exhaust system that leads directly to the outdoors;
b) an engineering analysis is performed to ensure that the exhaust system continues to perform its intended function and that the operation of the HVAC system is not compromised; and
c) the operation of the exhaust fan is monitored and alarmed to building operations staff and alarmed in the construction zone.

Note: *This Clause addresses situations when the permanent air handling system itself is used to exhaust air from the construction site. Clause 7.3.3.6.2 addresses a similar situation that can occur when air from CAHUs has to be ducted into the permanent system.*

7.3.3.4 Construction air handling units

CAHUs shall be performance verified, operated, and maintained in accordance with Clause 6.6.4.

7.3.3.5 Impact on the facility HVAC system

When CAHUs are installed for maintenance, renovation, and construction work, the air flow rates, distribution, and pressurization of a facility's HVAC system can be affected. Accordingly, the main facility system shall be verified for operation in accordance with design during construction work. The HCF and constructor shall verify the pressure relationships for critical areas near the construction area, i.e., Population Risk Group 4 areas (see Table 2).

7.3.3.6 Construction air handling

7.3.3.6.1

Permanent air handling systems should not be used for exhausting air from construction or renovation work areas, except in the following instances:

a) as specified in Clause 7.3.3.3.5 or 7.3.3.6.2, for situations where the building layout does not permit direct ducting from the construction area to the outside; or
b) as specified in Clause 8.3.5.3, in the final phase of new construction.

7.3.3.6.2

In cases where air cannot be exhausted directly outside, exhaust air may be temporarily ducted to the building exhaust system if

a) an engineering analysis has been performed by qualified personnel to ensure that exhaust air will not be re-entrained into the occupied building; and
b) the MDT approves the temporary ducting to the exhaust system.

Note: *This Clause addresses situations when air from CAHUs has to be ducted into the permanent system. Clause 7.3.3.3.5 addresses a similar situation that can occur when the permanent air handling system itself is used to exhaust air from the construction site.*

7.3.3.6.3

In cases where air cannot be exhausted directly outside or piped through the building exhaust system, it may be recirculated into areas of the building occupied by Population Risk Group 1 or 2 if MDT approval has been granted. Construction exhaust air shall not be recirculated into building areas occupied by Population Risk Group 3 or 4.

Note: *If air is recirculated within the building, the location and positioning of the discharge should take into account the direction and velocity of air flow, and the potential impact on relative pressurization and directional air flow in both the areas being supplied and in adjacent areas.*

7.3.3.7 Cleaning and maintenance

7.3.3.7.1

Constructors shall clean areas outside and immediately adjacent to the project entrances with a HEPA filter-equipped vacuum cleaner every day or more frequently if necessary (e.g., when there is visible debris).

7.3.3.7.2

Environmental services staff shall

a) increase the frequency of cleaning in areas adjacent to the construction area while the project is underway;
b) wet-mop and vacuum the area with a HEPA filter-equipped vacuum cleaner as necessary and when the work is complete; and
c) wipe exposed surfaces with a hospital-grade disinfectant.

7.3.3.8 Role of infection prevention and control personnel

Infection prevention and control personnel shall be responsible for

a) collaboration with the environmental services staff to ensure that the construction area is thoroughly cleaned when work is complete;
b) auditing the program for assuring integrity of the dust barriers; and
c) designating, in collaboration with the facility project manager,
   i) a traffic pattern for constructors that avoids patient care areas; and
   ii) a traffic pattern for clean or sterile supplies and equipment that avoids the construction area.

7.3.3.9 Role of health care staff

Health care staff shall

a) ensure that patient care equipment and supplies are protected from dust exposure;
b) ensure that patients do not go near the construction area;
c) ensure that staff do not visit the construction area; and
d) immediately report discoloured water and water leaks to the HCF's operation and maintenance staff and infection prevention and control personnel.

7.3.4 Preventive measure IV

Note: *See Figures E.3 to E.5.*

7.3.4.1

In addition to following PM I, II, and III, the requirements specified in Clauses 7.3.4.2 to 7.3.4.11 shall be met.

7.3.4.2

Entry to the construction area shall be either

a) from outside the occupied areas of the HCF; or
b) through an anteroom constructed in accordance with Clause 6.6.2.

7.3.4.3

Operation and maintenance staff or constructors shall

a) ensure that all access to the construction area is from outside the occupied areas of the HCF, or an anteroom if access is from within the HCF;
b) place a walk-off mat outside and inside all anterooms (as described in Clause 6.6.1.9) to trap dust from equipment, debris, and the footwear of personnel leaving the construction area with mat selection and maintenance as specified in Clause 6.6.1.9;
c) ensure that all the workers
   i) leave the construction area through the anteroom so that they can be vacuumed with a HEPA filter-equipped vacuum cleaner before leaving; or

ii) wear protective clothing that is removed each time they leave the construction area and before going into patient care areas;

d) follow appropriate procedures with personal protective equipment (PPE) to ensure that contaminants from the construction site are not transferred to patient care areas on their clothing;

Notes:

1) *Workers should be routed away from patient care areas wherever possible.*

2) *If workers have to pass through patient care areas, this requirement may be met by having them wear protective clothing while in the construction site and remove it immediately upon leaving the construction zone and before entering patient care areas.*

3) *If this is impractical, as an acceptable alternative, workers may don protective clothing before entering patient care areas.*

e) repair holes in walls or breaches in the polyethylene containment system immediately when found, and if a temporary repair is made, to complete the permanent repair within 2 h;

f) ensure that ventilation systems are working properly in adjacent areas; and

g) carefully remove barrier walls and use short-term protection to minimize environmental contamination during removal.

7.3.4.4

The constructor shall continually monitor the pressure differential between the construction zone and adjacent occupied areas by means of a differential pressure monitoring device with an integral data recorder. The differential pressure shall be continually recorded and the monitoring device shall report to a continuously surveilled location. The monitoring device shall be not closer than 5 m of the entrance to the construction site and be located on the adjacent or exterior side of the dust barrier. The monitoring device shall have an air hose intake on this exterior side and another air hose intake on the construction side not closer than 5 m to the exit door as to be relatively away from the influences of the opening of this door.

Notes:

1) *A continuously surveilled location may include having the differential pressure monitoring device report through the BAS to the constructor or other responsible party who should able to respond on a 24/7 basis. It may also be accomplished through technologies that autodial to a monitoring station or an autodial device that alerts the constructor regardless of location (paging or texting modules). Other means may be used provided that they have the approval of the MDT, e.g., reporting through a nurse call system to alert patient care staff of an equipment problem, which in turn allows them to contact the appropriate person (constructor or hospital staff) to address the loss of pressure.*

2) *There are times where the alarm system cannot practicably report to a continuously surveilled location. In such cases, the MDT should determine alternate methods to ensure immediate notification is received in the event of loss of differential pressure on the construction zone.*

3) *In smaller HCFs, continuous surveillance may be accomplished through the use of automatic dialers, a centrally monitored alarm panel, or other automated communications systems.*

7.3.4.5

The alarm set points for the differential pressure monitoring device shall be established by the MDT. In no case shall the alarm set points be set lower than 2.5 Pa with a maximum alarm delay of 90 s.

7.3.4.6

The constructor shall check the differential pressure record daily. If the record shows that monitoring device readings were less than 7.5 Pa of negative pressure within the construction zone for more than 4 h in any 24 h period, or less than 2.5 Pa for more than 90 consecutive seconds, the constructor shall take immediate corrective measures to restore and maintain the required pressure differential.

7.3.4.7
An MDT representative shall regularly visit the construction area to confirm that preventive measures are being followed. The frequency of their visits shall be determined by the MDT. These visits shall be documented, and these records shall be retained as part of the risk management documentation for the construction project.

7.3.4.8
Infection prevention and control measures shall be constantly monitored and shall be reviewed at the regularly scheduled construction and project management meeting.

7.3.4.9
If, during construction, events that can present infection risks occur, intervention procedures shall be implemented immediately to resolve the problems.

7.3.4.10
Plumbing and HVAC systems shall be supplied, installed, and commissioned in accordance with CSA Z317.1, CSA Z317.2, and CAN/CSA-Z8001.

7.3.4.11
Before patient or staff occupancy of the construction project work area is permitted, a project infection control work plan completion audit shall be completed. If the commissioning process identifies any uncompleted work from the infection control plan, this shall be listed as a project deficiency. In the event of such a deficiency, there shall be a revised work plan with the steps needed to attain the expected occupancy state, and this shall be reviewed and approved by the MDT. See Clause 7.3.3.

7.4 After construction

7.4.1 Preventive measure I
The MDT shall review the preventive measures that were undertaken and assess their effectiveness.

7.4.2 Preventive measures II and III

7.4.2.1
The MDT shall
a) review the preventive measures that were undertaken and assess their effectiveness; and
b) conduct a final check to ensure that the ventilation system is functioning properly in the construction area and adjacent areas.

7.4.2.2
Following construction, environmental services and health care staff shall
a) ensure that the construction area has been cleaned with a HEPA filter-equipped vacuum cleaner, a wet mop, or both, as necessary, and that horizontal work surfaces have been wiped with a hospital grade disinfectant; and
b) immediately report discoloured water and water leaks to the HCF's operation and maintenance staff and infection prevention and control personnel.

7.4.2.3

Infection prevention and control personnel shall ensure that the construction area has been terminally cleaned before building occupants are allowed to occupy the new space. The terminal clean shall be performed by the HCF's environmental services department or designated alternative cleaning contractor using a terminal cleaning procedure approved by the MDT.

Note: *Depending on the project, terminal cleaning could need to be performed more than once, e.g., it could be done both before and after the barrier walls come down.*

7.4.3 Preventive measure IV

The requirements specified in Clauses 7.4.1 and 7.4.2 shall be met. In addition, before the completed construction area is occupied, any portions of the infection control plan still in effect shall be reviewed by the MDT. If necessary, such portions shall be incorporated into the HCF's ongoing operating policies and procedures.

7.5 Ceiling access for investigation and minor work

7.5.1 General

7.5.1.1

The requirements in Clauses 7.5.2 and 7.5.3 apply to activities requiring ceiling access in occupied areas for investigation or minor work. Such work may be conducted by the facility's own qualified operation and maintenance or plant staff, or by qualified construction trades.

If HCF operation and maintenance staff or constructors are in doubt about the practical applications of Clause 7.5, the MDT or infection prevention and control staff shall be consulted.

7.5.1.2

Ceiling tiles showing observable contamination shall be accessed in accordance with the applicable requirements for repairs in Clauses 6 and 7. This Clause shall not apply in situations where there is observable contamination (e.g., stained and wet ceiling tiles).

7.5.2 Ceiling access exceptions for Construction Activity Type B and Population Risk Group 1 or 2

7.5.2.1

In areas where patients in Population Risk Group 1 or 2 are treated or accommodated, PM I may be applied to projects under the following conditions:

a) The project requires only ceiling access for investigation or minor work, and will be accomplished in a limited time as determined by the MDT (e.g., 10 min or less).
b) The construction activity is Type B, and involves only access or minor work above several ceiling tiles or hatches in hard ceilings where dust migration can be controlled, for minor electrical work or the repair of ventilation components, telephone wires, or computer cables.

7.5.2.2

For these projects, access shall be for no more than a limited time as determined by the MDT (e.g., 10 min per ceiling tile or hatch) in an occupied area with a HEPA vacuum running continuously at the point of removal of ceiling tile or hatch.

7.5.3 Ceiling access exceptions for Construction Activity Type A or B and Population Risk Group 3 or 4

7.5.3.1

In areas where patients in Population Risk Group 3 or 4 are treated or accommodated, PM II may be applied to projects under the following conditions:

a) The project requires only ceiling access for investigation or minor work and will be accomplished in a limited time as determined by the MDT (e.g., 10 min or less).
b) The construction activity type is
   i) Type A (see Table 3); or
      Note: *Type A activities in an area with Population Risk Group 3 are already listed as PM I in Table 1.*
   ii) Type B and involves only access or minor work above several ceiling tiles or hatches in hard ceilings where dust migration can be controlled, including cutting of ceilings for minor electrical work or the repair of ventilation components, telephone wires, or computer cables.
      Note: *Pulling of cables through walls or ceilings is a Type C activity and is not covered under this Clause.*

7.5.3.2

For the projects meeting the criteria in Clause 7.5.3.1, the following PM II precautions shall apply:

a) Construction shall take place entirely inside a containment unit that is sealed tight to the ceiling.
b) There shall be no patients in the room.
c) A HEPA-filtered vacuum shall be applied continuously at the point of removal of ceiling tile or hatch.
d) Constructors' clothes shall be HEPA vacuumed before exiting the containment unit.

8 Infection prevention and control measures for new construction projects

8.1 General

8.1.1

This Clause outlines required infection prevention and control measures based on

a) the type of construction project, e.g., a greenfield project, or an addition to an existing HCF;
b) the proximity of the building site to other HCF buildings;
c) the patient populations potentially affected by the construction; and
d) the activities taking place at a particular phase of the project.

Notes:

1) *See Clause 7 for requirements applying to renovations, repairs, and maintenance.*
2) *New construction can create both short- and long-term risks. Long-term risks, if not prevented, can lead to serious infection control problems, even years after occupancy.*

8.1.2

Prior to the commencement of a new construction project, and before construction work begins, the project MDT shall engage an infection control specialist (whether internal or external) who will consult with, and advise the team on infection control matters. The project MDT, along with the infection control specialist, shall perform a preliminary overall ICRA and complete a preventive measures analysis form, which will include the process to determine the category of the project and the times and areas where infection prevention and control measures are necessary. The MDT shall complete a preventive

measures analysis form. A copy of this form shall be kept by the HCF. The MDT shall communicate its requirements through the design team before the project is tendered and construction begins.

Once a constructor has taken over the construction project, and before construction work begins, the site MDT shall perform, or participate with the constructor in performing, an overall ICRA and complete the preventive measures analysis form for the specific construction project.

Notes:

1) *See Annex C for a sample preventive measures analysis form.*

2) *The MDT may categorize projects up or down based on the number and nature of the foot traffic and utility connections between buildings. For example, it may designate an existing-location project as Category 2 instead of 3 if staff access to the existing building(s) is infrequent and easily controlled.*

8.1.3

New construction projects shall be categorized as one of the following:

a) **Category 1—New location:** Construction of a new building on land that is
   i) geographically isolated from existing health care facilities (e.g., on a vacant parcel of land that is not part of an existing facility campus); and
   ii) at a sufficient distance from existing HCFs that the activities associated with construction will not in any way impair the air quality or water quality (with respect to pathogenic organisms, mould, bacteria, or dust) of another HCF.

b) **Category 2— Existing detached location:** Construction of a new building on land that is geographically associated with an existing HCF building, but is not connected for the purpose of normal foot traffic.

   Note: *This category refers to buildings that are near each other but not linked by corridors (i.e., one would have to go outside to get from one to the other). The buildings could be linked by other means such as utility connections, tie ins, or routing of existing services such as mechanical, electrical, plumbing, medical gas, medical vacuum, IT cabling, service tunnels, etc.*

c) **Category 3— Existing connected location:** Construction of a new building or addition that is directly connected to an existing HCF building (i.e., such that normal foot traffic is possible between buildings without going outside).

8.1.4

Infection prevention and control measures for new construction projects in Categories 1, 2, and 3 shall be in accordance with Clauses 8.1.5 to 8.4. Renovation projects (other than minor refurbishing and cosmetic upgrades) shall be evaluated to determine whether or not they constitute new construction. The renovation should be treated as Category 2 or Category 3 new construction (depending on the connection to the existing facility) if any of the following apply:

a) the project changes the function of the renovated area (e.g., converting office space into clinical areas);
b) life safety systems will be replaced; or
c) the building exterior will be substantially changed.

The MDT shall be responsible for the final decision as to whether a renovation is to be treated as new construction.

8.1.5

All new construction projects shall be divided into construction phases for infection prevention and control planning. These shall include each of the phases addressed in Clauses 8.3.2 to 8.3.6.

Note: *The project phases for new construction are*

a) *Phase 1 — excavation, foundation, building envelope, and floors;*

b) *Phase 2 — walls and ceilings;*
c) *Phase 3 — interior finishing;*
d) *Phase 4 — final finishing; and*
e) *Phase 5 — completion and follow-up activities.*

8.1.6

The constructor's on-site team shall include at least one person (e.g., an infection prevention and control consultant) with demonstrated knowledge and experience in infection prevention and control during construction. The constructor shall designate an individual (i.e., that person or someone with similar qualifications) who will have primary responsibility for infection prevention and control before, during, and after the project. This person's role will be to liaise with the facility project manager (and the MDT) and to oversee, advise on, coordinate, and monitor the constructor's infection control measures and procedures.

8.1.7

The project MDT (see Clause 6.2.1.1) shall designate a representative to communicate with the facility project manager and attend construction meetings as necessary.

Note: *Separate project meetings for infection prevention and control issues and incident review may be held outside of construction meetings through the project manager when needed to specifically focus on plans, progress, and issues related to infection prevention and control. For large projects or for those taking place over a long period, regular infection prevention and control-specific meetings should be scheduled.*

8.1.8

For Category 3 projects, environmental separation between the buildings shall be achieved and maintained from the time before construction begins until final finishing is complete.

Note: *The appropriate method for separating buildings will depend on the physical layout of the buildings, the nature of the project, and the risk level for patients and staff.*

8.1.9

Shipping, handling, and storage of construction materials shall be in accordance with Clause 5.3.

8.1.10

Specific expectations regarding site cleanliness at various stages of construction and at hand-over should be outlined in the hand-over clauses in the construction agreement and in the infection control plan.

8.1.11

For construction in existing connected locations (Category 3), the facility project manager or designate shall ensure that patient care equipment and supplies are protected from exposure to dust.

Note: *Dust that is generated or disturbed during construction can migrate to occupied areas and contaminate patient care equipment and supplies.*

8.1.12

Separation shall be maintained between finished and unfinished areas at different stages of construction to prevent the infiltration of dust and micro-organisms from unfinished areas. Separation

shall be horizontal or vertical, as applicable to the layout of the HCF, i.e., if the project is a multi-story building and different levels are at different phases, vertical separation shall be used as well.

Note: *Vertical separation can be accomplished by the use of one or more of the following means:*

a) *using stairwells as negative air anterooms;*
b) *using building features (e.g., unused elevator shafts) to control relative pressures and minimize dispersion of particles;*
c) *if a material hoist is being used, adding a negative air anteroom at the hoist entrance/exit; and*
d) *installing or erecting temporary barriers.*

8.2 Before construction

8.2.1

Before commencing construction, the constructor shall present their developed infection control plan through the project team to the MDT for review, discussion, comment, and approval. See Clause 6.1.5.

The proposed construction and terminal clean process and methods shall be developed and approved as part of the final infection control plan. A copy of the plan shall be provided to all subcontractors and suppliers along with a contractual requirement to comply with its relevant provisions.

Note: *Infection prevention and control requirements should also be communicated in other contractual-related documents, such as work or purchase orders, independent purchases, standing agreements, etc.*

8.2.2

The constructor leadership shall have demonstrated experience and knowledge of IPC during construction.

Note: *Such experience and knowledge may be demonstrated, for example, by presenting proof of training classes completed, or documentation showing successful application of this Standard in HCFs in the past, or work performed with supervisors experienced in the application of this Standard.*

8.2.3

On approval of the infection control plan and the project-specific orientation training program by the MDT, the constructor shall provide or arrange for infection prevention and control orientation training sessions for all subcontractor and supplier personnel participating in the project and who will be entering the construction site and related construction areas (see Clause 6.1.6). Training and orientation shall be documented and records maintained in accordance with HCF policy.

8.2.4

Workers who for any reason have not received infection prevention and control orientation shall work with, or be supervised by, a worker who has received this training. The untrained workers should undertake this orientation training within no more than one week from the start of their work.

8.2.5

The project team shall review the materials and techniques to be used in the project in terms of their implications for infection prevention and control. The review shall consider the selection, design, application, specification, and assembly of construction materials.

Note: *This consideration should extend to long-term planning, i.e., the possibility of an occupant acquiring an infection during the lifetime of the new structure(s).*

8.2.6

Before commencing construction, the constructor shall institute infection prevention and control measures in accordance with the infection control plan for the duration of the construction project and, where applicable, for ongoing maintenance and operations.

Ongoing scheduled review of the infection prevention and control measures by the constructor and the MDT through the HCF project manager shall occur as the construction progresses through different phases to ensure implemented plans and measures are reflective of actual activity. If conditions change significantly or new information is received during construction, the infection control plan shall be reviewed and any necessary changes shall be made by the constructor, with approval from the MDT.

8.2.7

For Category 2 or Category 3 construction (i.e., in existing locations), the HCF project manager shall ensure that essential services (e.g., water supply, electricity, and ventilation systems) that could be disrupted by construction are identified. There shall be a system shutdown contingency plan, approved by the MDT, that specifies how the HCF would address each type of disruption. The approved plan shall be communicated to health care staff responsible for the patients who could be affected by the disruption.

Note: *The systems shutdown contingency plan would address, for example, the provision of alternative water sources if the domestic water supply is disrupted.*

8.2.8

For Category 2 or Category 3 construction, clinical staff shall work with infection prevention and control personnel to identify high-risk patients and, if necessary, relocate them away from the construction area temporarily to minimize exposure to possible contaminants (see Clause 4.3).

Note: *For example, patients who are immunosuppressed should be relocated away from the construction areas prior to construction commencement if the required air quality cannot be reliably maintained during the planned construction task or operation.*

8.2.9

For Category 2 or Category 3 construction, drawings shall be obtained that show the layout of

a) water supply and drains; and
b) ventilation systems that supply air to, or exhaust air from, the work area.

If as-built drawings are not available, an on-site investigation shall be conducted to locate and document with the drawings of the essential elements of the plumbing and ventilation systems.

Based on the information in the drawings, or gathered through investigation, the project team shall determine whether it is necessary to close outlets, modify performance, shut down systems, or make other changes to the HVAC system.

8.2.10

For Category 3 construction (i.e., in existing connected locations), the site MDT, in conjunction with the facility project manager, shall

a) determine a safe route for the transportation of clean or sterile supplies and equipment (i.e., away from construction areas);

b) establish traffic patterns for construction workers (i.e., that avoid patient care areas);

Note: *If patient care areas cannot be practically avoided, the constructor should, at the minimum, reduce potential adverse impacts on those patient care areas by developing alternate traffic patterns and routes for construction workers.*

c) minimize exhaust output from the elevator shaft and cab in the construction area, via physical air separation and maintenance of differential pressure ventilation, to ensure that the air does not enter or is not recirculated into the HCF and, if possible, designate an elevator for use solely by construction workers;
d) establish water temperature standards for the HCF (see CSA Z317.1); and
e) determine whether domestic cold, hot, and recirculation water lines will be affected by the construction, and if so, shall perform an assessment, as appropriate to the extent and duration of the disruption, in accordance with Clause 8.2.11.

8.2.11

The plumbing system assessment by the project team shall include

a) identifying plumbing lines that will need to be shut off or interrupted using existing valves, isolated by additional valves, bypassed via diversion systems, or installing a recirculation system;
b) determining the method to be used to disinfect the water lines before occupancy;
c) drafting the procedure to be used to disinfect the water system, including identifying the required equipment; and
d) determining the flow path to be used to hyperchlorinate and flush water lines affected by the construction.

8.2.12

If an elevator shaft is part of the construction, there shall be hoarding of elevator access at all other floor levels, unless the access is used exclusively by the constructor for management of debris, supplies, etc.

If an elevator is not part of the construction, but is used for the movement of debris or supplies, consideration should be given to hoarding off or otherwise restricting all other access to the elevator at each floor or level.

Infection control barrier warning signage shall be posted where hoarding or other barriers have been installed.

8.2.13

For Category 3 construction, operation and maintenance staff or constructors shall erect an impermeable dust barrier or install an impermeable containment vessel before construction starts, as follows:

a) To seal off an area, an impermeable dust barrier shall be erected from the floor to the underside of the deck (including the areas above false ceilings) consisting of two layers of 6 mil fire-retardant polyethylene and gypsum wallboard protection (or an equivalent barrier) that is accepted by the MDT. The polyethylene membrane shall be present under all circumstances to maintain the required pressurization (see Clause 6.6.1). The dust barrier shall remain in place until the project is complete and the area has been cleaned thoroughly and inspected. After construction has been completed, the dust barrier shall be removed to minimize the spread of dust and other debris particles adhering to the barrier.

Note: *Removal of the dust barrier may be accomplished by*

a) *vacuuming surfaces with a HEPA-filtered vacuum;*

b) *taking down the barrier and cleaning it again by vacuuming (if practicable) and damp wiping surfaces; and*
c) *rolling up the polyethylene, construction side in (if it is separate from the hard wall) to contain the dust.*

b) Where an isolated project is to be done in an active patient care area, an impermeable temporary containment unit (vessel) may be used. The containment unit shall have a monolithic (one-piece) exterior shell constructed of a minimum of 8 mil fibre-reinforced, fire-retardant polyethylene. The containment unit shall be constructed to prevent the release of contaminants to surrounding areas, and it shall have ports through which HEPA-filtered vacuum cleaners or other CAHUs (see Clauses 6.6.3 and 6.6.4) can be easily attached to draw the unit under negative pressure.

Where deemed appropriate by the MDT, the composition of the barrier in Items a) or b) may be modified to suit time or space constraints, or to manage potential impacts of preventive measures.

Note: *There could be instances when the building or installation of the barrier, or the subsequent removal as prescribed, could have negative impacts beyond the potential risks posed by construction. This Clause offers the MDT the option to use alternative methods of containment provided that risk management and patient safety considerations are met.*

8.2.14

At the completion of the work, and prior to barrier removal, operation and maintenance staff or constructors shall vacuum mechanical and electrical systems (and associated components) and spaces above drop or false ceilings if necessary.

8.2.15

Measures shall be used to ensure that contaminants from the construction site are not carried into patient care areas on workers' clothing.

Notes:

1) *Workers should be routed away from patient care areas wherever possible.*
2) *If workers have to pass through patient care areas, this requirement may be met by having them wear protective clothing while in the construction site and remove it immediately upon leaving the construction zone and before entering patient care areas.*
3) *If this is impractical, as an acceptable alternative, workers may don protective clothing before entering patient care areas.*

8.2.16

For Category 2 or 3 construction the following precautions shall be taken before construction:

a) sealing windows and unused doors;
b) sealing plumbing penetrations, electrical outlets, and any other sources of potential air leaks in the construction area; and
c) placing a walk-off mat outside the entrance to the construction area to trap dust from the equipment and footwear of personnel leaving the area, with mat selection and maintenance as specified in Clause 6.6.1.9.

Note: *As a diagnostic tool, qualitative smoke tubes may be used to confirm proper sealing and check for potential air leakage paths from the construction area to occupied patient care areas.*

8.2.17

In new construction projects, temporary heating/cooling may be provided through the use of the building's permanent HVAC system (in whole or in part), provided that the following requirements are met:

a) Such use shall be approved by the MDT, owner, constructor, and mechanical design consultant.

b) The constructor shall prepare a site-specific temporary heating/cooling plan and shall submit it to the MDT for approval.
c) Air handling units that are used for temporary heating/cooling shall have filtration provided in accordance with the final design of the air handling unit or better.
d) Exposed openings for supply air duct systems shall remain closed until continuous filtered air flow is provided without interruption.
e) Return air system duct work shall remain sealed in accordance with Clause 5.3.3.6.
f) Airflow within the ductwork shall positively pressurize all portions of the permanent ductwork that are being used to provide temporary heating or cooling.
g) Exhaust, when needed, shall be performed using a temporary exhaust system that is not connected to the building's exhaust system, and which is removed from the site at the end of construction. An exception may be made in the final finishing phase of the project (Phase 4) if the conditions of Clause 8.3.5.3 are met.
h) The use of the permanent HVAC system for temporary heating or cooling shall be coordinated, as needed, with the commissioning of the HCF and its mechanical systems.

Notes:

1) *The decision whether or not to use a system for construction air flow should take into account the warranty terms and limitations for equipment such as air handling units to ensure that such use will not void the warranty.*

2) *Cleaning of the system at the end of construction and prior to turnover is addressed in Clause 5.3.3.7.*

8.2.18

Planned disruptions of air flow in the permanent ductwork shall not exceed 2 h and shall not take place during dust generating activities. If a planned disruption of more than 2 h is unavoidable, all vents and other openings in the system shall be covered with filter media or sealed at the start of the work.

If a planned or unplanned interruption occurs, and it lasts longer than 2 h, the ductwork shall be visually inspected, and if visible contaminants are evident it shall be cleaned in accordance with *NADCA General Specification for the Cleaning and Restoration of Commercial Heating, Ventilating and Air Conditioning Systems* and CSA Z317.2 prior to restart.

Note: *Disruption of air flow might be the result of equipment failure or a planned transition from temporary heating/cooling to permanent heating/cooling.*

8.2.19

If the HVAC system is used for temporary heating during construction, there shall be backup heating units on site to protect any parts of the system that are vulnerable to freezing, e.g., hot water floor heating units.

Note: *The use of temporary heating and cooling systems along with the permanent ductwork systems in new construction, if done properly, can help to ensure that, during the assembly and installation of the ductwork of grilles and diffusers, dust from construction activities will be prevented from migrating into the ductwork system due to the positive air pressure in the ducts. Constant airflow through the ductwork system can help to prevent stagnant pockets of air or moisture from forming between the time the ductwork is assembled and start-up time for the permanent air systems.*

8.3 During construction

8.3.1 General

8.3.1.1 Dust control

8.3.1.1.1

Constructors shall execute their work using methods that minimize dust generation and migration into the atmosphere in all phases of a Category 3 construction project and in phases 4 and 5 of construction projects identified as Category 1 or 2.

Note: *New construction project phases are summarized in the Note to Clause 8.1.5.*

Examples of such methods include

a) using drop sheets to control dust, or suitable, alternative materials as approved by the MDT;
b) using HEPA-filtered tools or equipment to capture generated dust;
c) controlling dust by water-misting work surfaces while cutting (using appropriate electrical safety measures);

   Note: *Caution should be exercised when such techniques are used on cellulose or fibre-based materials that are intended to stay in place following construction work.*
d) sealing all air vents in the construction area; and
e) placing a walk-off mat outside the entrance to the construction area.

8.3.1.1.2

Supplies and equipment that is transported through or around occupied areas shall be in covered (or sealed) containers during transportation through the HCF to prevent contamination in other areas.

8.3.1.1.3

In Category 2 and 3 construction, exposure of the occupants of the HCF to dust and debris shall be minimized. Where practical, construction dust and debris shall be cleaned or removed in the evening when patients are in their rooms and visitors have left. If this is not practical, dust and debris shall be cleaned and removed as soon as possible, and no later than the end of the workday or at the completion of the specific task or operation.

If construction debris is to be transported through or around occupied areas, it shall be contained by either

a) placing it in a covered (or sealed) container; or
b) covering it with a dampened material (approved by the MDT) that cannot support microbial growth, to prevent the escape of dust.

8.3.1.1.4

Operation and maintenance staff or constructors shall

a) ensure that all access to the construction area is from outside the occupied areas of the HCF, or construct anterooms if access is from within the HCF;
b) place a walk-off mat outside and inside all anterooms to trap dust from equipment, debris, and the footwear of personnel leaving the construction area, with mat selection and maintenance as specified in Clause 6.6.1.9;
c) place boot scrubbers or boot wash stations, or both, as needed to limit transmission of soil from dirty to clean areas, with maintenance as specified in Clause 6.6.1.10;

d) ensure that the constructors
   i) leave the construction area through the anteroom so that they can be vacuumed with a HEPA filter-equipped vacuum cleaner before leaving; or
   ii) follow procedures to ensure that contaminants from the construction site are not carried into patient care areas on workers' clothing;

   Notes:
   1) *Workers should be routed away from patient care areas wherever possible.*
   2) *If workers have to pass through patient care areas, this requirement may be met by having them wear protective clothing while in the construction site and remove it immediately upon leaving the construction zone and before entering patient care areas.*
   3) *If this is impractical, as an acceptable alternative, workers may don protective clothing before entering patient care areas.*
e) repair holes in walls within 2 h or seal them temporarily; and
f) ensure that ventilation systems are working properly in adjacent areas.

8.3.1.1.5

All ventilation provided to construction areas should be filtered through a MERV 8 pre-filter at the intake. In circumstances of extreme cold or heat, it might not be suitable to bring in supply air though a MERV 8 filter due to the large energy costs associated with the activity. The constructor should then consider the option of recirculating air through CAHUs in all parts of the facility once the perimeter walls and roof are installed. In these circumstances, temporary heaters or air conditioning units may be used in-line with these CAHUs via the intake of the CAHU. Where construction sites abut occupied areas, the size and quantity of the CAHU's shall be sufficient to maintain the relative pressurization specified in Clause 6.6.1. Refer to Annex F for sizing criteria and examples.

8.3.1.1.6

For Category 3 construction locations, environmental services staff shall
a) increase the frequency of cleaning in areas adjacent to the construction area while the project is underway;
b) wet mop (or damp wipe) and vacuum the area with a HEPA-filtered vacuum cleaner as necessary and when the work is complete; and
c) wipe exposed surfaces with a hospital-grade disinfectant.

8.3.1.1.7

In Category 2 and 3 projects, air from construction, maintenance, or repair areas shall not be discharged to areas occupied by Population Risk Group 3 or 4. Air from construction, maintenance, or repair areas shall not be recirculated to any part of the HCF unless specifically approved by the MDT. If recirculation is permitted, CAHUs shall be performance leak tested and performance tested to ensure that proper HEPA filtering is taking place. See Clause 8.3.1.1.5.

8.3.1.1.8

In Category 2 and 3 new construction, the relative space pressures between areas occupied by Population Risk Group 3 or 4 shall be monitored at all times using pressure differential monitoring devices connected to an alarm that sounds at a continuously surveilled location.

Where the failure of either the CAHU or the exhaust fan would compromise the relative pressurization of a Population Risk Group 4 area, the systems shall be interlocked.

8.3.1.2 HVAC Systems and Ventilation

8.3.1.2.1

For Category 3 construction, and in Category 2 locations where the ventilation system is connected to both the new and old buildings, operation and maintenance staff or constructors shall

a) disable the ventilation system and seal all vent openings in the construction area until the project is completed;
b) maintain differential pressure within the construction area by using CAHUs that include a differential pressure monitoring device and an alarm. Filters shall be monitored and replaced if clogged or functioning below the manufacturer's specifications;
c) ensure that the air is exhausted directly outside (if possible) and away from intake vents and other identified openings and filtered through a HEPA filter; and
d) ensure that the ventilation system is functioning properly and is cleaned if contaminated by soil or dust after the construction project is complete.

8.3.1.2.2

To prevent uncontrolled ventilation, any ceiling tiles that are either missing or damaged (e.g., cracked, moisture damaged, or contaminated by mould) should be promptly replaced with clean, dry tiles.

8.3.1.2.3

The negative pressure of 7.5 Pa in the construction area shall be monitored by the constructor using a pressure differential monitoring device connected to a continuously surveilled alarm. The alarm shall provide an audible or visual signal at the alarm location, as well as at a remote location, if needed for continual monitoring. The MDT shall specify whether the alarm signal is to be audible, visual, or both. The pressure differential monitoring device and other monitoring equipment shall be maintained and zeroed and calibrated in accordance with the manufacturer's instructions.

Note: *The alarm should be connected to the BAS; however, if this is not possible, the MDT should arrange an alternative system for alarm monitoring or logging.*

8.3.1.2.4

The constructor shall record in a log sheet on a daily basis the pressure differential from the monitoring device. If the pressure differential is less than 7.5 Pa of negative pressure within the construction zone for more than 4 h, or if it drops to less than 2.5 Pa for more than 90 s, the constructor shall take immediate corrective measures to restore and maintain the required pressure differential.

8.3.1.2.5

The HCF shall immediately notify through established communication avenues and means the constructor when a construction pressure differential alarm is received through the BAS.

8.3.1.2.6

For Category 3 construction, when CAHUs are installed for maintenance, renovation, and construction work, the air flow rates, distribution, and pressurization of a facility's HVAC system can be affected. Accordingly, the main facility HVAC system shall be verified for operation in accordance with design during construction work. The HCF and the project team shall verify the pressure relationships for critical areas near the construction area, i.e., Population Risk Group 4 areas (see Table 2).

8.3.1.2.7

Permanent air-handling systems shall not be used for exhausting air from construction or major renovation work areas during construction, except at the final finishing stage if done in accordance with Clause 8.3.5.3. Temporary ductwork may be installed for air exhaust from the construction site; however, it shall not connect to the facility's HVAC system.

8.3.1.2.8

If the new ductwork in a new construction project is being used for temporary ventilation of the construction area, the following measures shall be used to ensure the continued cleanliness of the system:

a) All means of providing air through the ductwork system shall be filtered at a level at least as high as the final end user specification, and using, at minimum, MERV 8 pre-filters and MERV 13 final filters.
b) The airflow through the ductwork system shall always remain positive and shall never be interrupted.
c) Airflow into the ductwork shall be produced by means of one or any combination of the following:
   i) indirect fired construction heaters;
   ii) glycol dry heat fan coils;
   iii) CAHUs; or
   iv) independent cooling systems.
d) Backup or redundancy in the air supply systems shall be proven prior to pressurizing the ductwork systems.
e) The temporary system shall be continuously surveilled to ensure proper operation and to prevent damage. Monitoring shall include air flow and air pressure, and the temporary system shall be designed to shut down on alarm. Means shall be provided to ensure that over-pressurization of the ductwork does not occur.

   Note: *The necessary monitoring may be achieved using the building management system or BAS with modifications for temporary use.*
f) If the building management system or BAS are used, such use shall be conducted in consultation with the controls contractor and the HCF operation and maintenance staff responsible for the HVAC system.
g) Alarms shall be monitored by designated construction and controls staff.
h) In the transition from temporary heating and cooling systems supplying air to the ductwork to the use of the permanent systems, the temporary system shall remain as a backup until the permanent systems have been commissioned.

   Note: *This will ensure positive air flow through the ductwork systems will be maintained throughout the duration of the construction project.*

8.3.1.2.9

HVAC systems shall be supplied, installed, and commissioned in accordance with CSA Z317.2 and CAN/CSA-Z8001.

8.3.1.3 Plumbing

8.3.1.3.1

Constructors performing plumbing work shall

a) avoid the use of collection tanks and long pipes (which can allow water to stagnate) in the installation;

b) maintain a dry work environment and immediately report any water leaks through walls or substructures;
c) be aware of the impact of techniques to remove bacterial growth and choose the approach that minimizes the associated risks to patients, staff, or the plumbing system; and
d) disinfect domestic water systems or sections of systems that have been stagnant (especially if *Legionella* is suspected or known to be present in the domestic water supply) in accordance with Clause 6.8.

Note: *Technologies designed to prevent micro-organism growth in plumbing systems (e.g., silver-copper ion treatments) may be used to supplement the system disinfection specified in Item d).*

8.3.1.3.2

Water lines in the construction area and adjacent patient care areas shall be flushed before use or reuse.

8.3.1.3.3

Plumbing systems shall be supplied, installed, and commissioned in accordance with CSA Z317.1 and CAN/CSA-Z8001.

8.3.1.4 Monitoring

8.3.1.4.1

Infection prevention and control measures shall be constantly monitored and shall be reviewed at regular construction and project management meetings. Checklists and method statements shall be completed by the constructor to indicate monitoring/completion of activity and review of indicators, appropriate to the category of project and the phase of construction (e.g., for a connected addition, monitoring would include readings of the negative pressure differential monitors, humidity, condition of site at close of day, and confirmation that HEPA temporary air handling units are operating continuously).

Documentation of monitoring activities related to the infection control plan shall be maintained and reviewed on a regular basis by the MDT or ICP. These records shall be retained as part of the risk management documentation for the construction project.

Note: *Annex G provides sample checklists for various activities and functions under this Standard.*

8.3.1.4.2

An MDT representative shall regularly visit the occupied side of the construction area to confirm that preventive measures are followed. The frequency of their visits shall be determined by the MDT.

8.3.1.4.3

If, during construction, events that can present infection risks occur, intervention procedures shall be implemented immediately to resolve the problems. These events shall be documented with the corrective actions and shall be reviewed by the MDT for comments and possible revisions to the infection control plan to ensure there are no recurrences.

8.3.1.4.4

For construction in existing locations, infection prevention and control personnel shall ensure that an effective surveillance system is in place to monitor patients for *Legionella* during soil excavation on, or in proximity to, HCF grounds or when the water supply has been disrupted and then re-pressurized.

8.3.1.4.5

Environmental services and health care staff shall immediately report discoloured water and water leaks to the HCF's operation and maintenance staff and infection prevention and control departments.

8.3.1.4.6

For existing connected locations

a) infection prevention and control personnel, in collaboration with the HCF project manager, shall designate a traffic pattern for constructors that avoids or minimizes potential adverse impacts on patient care areas and a traffic pattern for clean or sterile supplies and equipment that avoids the construction area;
b) the project management work plan shall include provisions for environmental services staff to ensure that the construction area is thoroughly cleaned when work is complete; and
c) the MDT shall be responsible for confirming the integrity of the dust barriers.

8.3.1.4.7

For existing connected locations, health care staff shall

a) ensure that patient care equipment and supplies are protected from dust exposure;
b) ensure that patients do not go up to or inside the construction area;
c) ensure that staff do not visit (i.e., go inside) the construction area without following proper procedures and protocols; and
d) immediately report discoloured water and water leaks to the HCF's operation and maintenance staff and infection prevention and control personnel.

8.3.2 Construction Phase 1 — Excavation, foundation, building envelope, and floors

8.3.2.1 General

This Clause covers construction from the time construction activities begin, through the pouring of foundation and floors, to the point when the roof and exterior wall systems are ready to be installed.

8.3.2.2 Dust control

8.3.2.2.1

After concrete installation, walk-off mats and boot scrubbers or boot wash stations, or both, shall be provided at the point of access to buildings and maintained daily.

8.3.2.2.2

Once the constructor has taken possession of the construction site and construction has commenced, the site and associated work areas shall be maintained in an organized and clean manner, and kept free of debris and materials though regular sweeping.

8.3.2.2.3

Concrete areas shall be swept, with a sweeping compound that does not contain hazardous materials (i.e., crystalline silica), when debris covers more than 25% of the open floor surface (i.e., less than 75% of the floor surface is visible). Sweeping compound shall be used for all sweeping.

8.3.2.3 Ventilation

Construction areas shall be ventilated once areas are enclosed. Ventilation may be provided using construction air-handling equipment producing filtered or unfiltered outside air.

8.3.3 Construction Phase 2 — Walls and ceilings

8.3.3.1 General

This Clause covers the construction activities from the time the concrete is finished and cured, to the time when the drywall is complete and primed and the process of installing sealed ducts, electrical conduit, and piping is starting. The exterior walls and roof are completed by the end of this phase.

8.3.3.2 Dust control

8.3.3.2.1

Work areas shall be kept free of debris and materials. The constructor shall follow construction clean protocols.

8.3.3.2.2

Work areas shall be cleaned daily as follows:

a) Work areas shall be swept (with a non-hazardous sweeping compound) or vacuumed with a HEPA-filtered vacuum, or both, at the completion of the specific work task or operation, or, at the minimum, at the end of each shift.
b) Common areas shall be swept once a day with sweeping compound or vacuumed with a HEPA-filtered vacuum or washed with a walk behind floor scrubber, and more frequently when gross soiling activities occur in the work areas or at the entrances to the building. Boot cleaning systems should be placed at the entrances to the building to prevent gross soil from entering.

8.3.3.2.3

A major site cleanup that provides a complete general clean shall be performed weekly or sooner, where required.

8.3.3.2.4

As each floor progresses from an open to an enclosed state, ventilation of enclosed work areas should include use of CAHUs. When using outside air for ventilation, that air shall be filtered with a minimum MERV 8 filter using construction air handling equipment or a temporary system in accordance with Clause 8.3.1.2.

8.3.3.2.5

All vacuum cleaners shall be HEPA-filter equipped.

8.3.3.2.6

All hidden cavities, including stud wall cavities, infrastructure above the ceiling plane, plumbing, and duct chases etc., shall be cleared of debris and HEPA vacuumed prior to enclosing.

8.3.3.2.7

Electrical and junction boxes shall be vacuumed out regularly and especially after final sanding, and prior to drywall prime, as well as after any sanding of the prime coat, where conducted.

Note: *This is intended to prevent dust from entering the conduit and to maintain the overall cleanliness of the electrical system.*

8.3.3.2.8

Infrastructure above the ceiling plane (i.e., pipes, structural elements, ducts, and other surfaces) shall be vacuumed with a HEPA-filtered vacuum and damp wiped after they are installed. Installation should be in sequence from higher to lower and surfaces in higher areas should be HEPA vacuumed and damp wiped before components are installed in lower areas in conjunction with an audit checklist.

8.3.3.2.9

At the end of this construction phase all ceiling spaces that are meant to be accessible shall be HEPA vacuumed and all areas that can be practically reached shall be damp wiped.

8.3.3.2.10

There shall be an inspection by the MDT representative prior to the installation of the T-bar, and then another inspection just before ceiling tiles are installed.

8.3.4 Construction Phase 3 — Interior finishing

8.3.4.1 General

8.3.4.1.1

This Clause covers the construction activities from the time the exterior walls and roof are complete, drywall is complete and primed, and installation has begun for sealed ducts, electrical conduit, and piping, to the time when the acoustic ceiling is installed, final duct work is complete, and diffusers and millwork are installed. At this stage areas are habitable, but are not appropriate for patient care.

Note: *The activities in this construction phase fall generally within Type C; however, certain jobs during this phase could require more stringent preventive measures.*

8.3.4.1.2

Contemplated change orders shall be evaluated in relation to the infection control plan and the preventive measures analysis for their potential impact on infection prevention and control, and additional preventive measures shall be incorporated into the work plan, when required.

8.3.4.1.3

Areas at the interior finishing stage shall be isolated from any areas that are at earlier stages of construction through the use of a negative air anteroom with polyethylene hoarding and walk off mats.

Note: *See Clause 6.6.2 for requirements for negative air anterooms.*

8.3.4.1.4

As building cavities (walls, ceiling spaces) are closed, all visible debris and soil shall be removed from these spaces and they shall be HEPA vacuumed prior to closing them.

Note: *Although there is inevitably reintroduction of small amounts of construction debris (e.g., drywall dust) as final finishes and installations are completed, the infection prevention and control principles of confining, containing, and minimizing the amount of gross debris left in these spaces should be followed.*

8.3.4.1.5

Construction activities shall be staged with “backing out” of finished areas in mind. Carpets or other finish materials that are likely to become contaminated by construction worker traffic or activities shall not be installed until construction traffic and activities are completed in the area. Materials that cannot be installed later or are already in place shall be protected from contamination.

Note: *The MDT should be consulted on the appropriate means for protecting materials from contamination, based on the type of material, the activities taking place in the area, and the length of time that protection is needed.*

8.3.4.2 Dust control

8.3.4.2.1

Work areas shall be regularly kept free of debris and materials.

8.3.4.2.2

Work areas shall be regularly cleaned as follows:

a) Work areas shall be swept or HEPA vacuumed, or both, at the end of each shift or at the end of each task performed by trades.
b) Common areas shall be swept with a non-hazardous sweeping compound, scrubbed with a mechanical floor maintenance washer, or vacuumed with a HEPA-filtered vacuum. This shall be done at least daily, and more frequently during times when work activities generate gross soil or dust.

8.3.4.2.3

A site cleanup shall be performed at least weekly, and more frequently if needed, to maintain construction clean protocols.

8.3.4.2.4

Once the project has reached a semi-clean stage, separate enclosures shall be provided for activities that generate a large amount of dust (e.g., a cutting room). This space shall be isolated from the HVAC system and kept under negative air pressure via HEPA-filtered CAHUs or HEPA vacuums. Separation should be accomplished through the use of 6 mil poly, with construction air, where used, vented to the outside.

8.3.4.2.5

All ventilation provided to construction areas should be filtered through a MERV 8 pre-filter at the intake.

8.3.4.2.6

All vacuum cleaners shall be HEPA filter-equipped.

8.3.4.2.7

Electrical and junction boxes shall be vacuumed out regularly and especially after final sand, and prior to drywall prime, as well as after any sanding of the prime coat, where conducted.

8.3.4.2.8

Infrastructure above the ceiling plane (i.e., pipes, structural elements, ducts, and other surfaces) shall be vacuumed with a HEPA-filtered vacuum or damp wiped, or both, after they are installed. Installation

should be in sequence from higher to lower and surfaces in higher areas should be HEPA vacuumed and damp wiped before components are installed in lower areas. Every effort shall be made to clean surfaces of dust before they might become inaccessible with the installation of other phases of infrastructure.

8.3.4.2.9

At the end of this construction stage, all ceiling spaces that are meant to be accessible shall be HEPA vacuumed or wiped down with a damp cloth, or both, and all areas that can be safely reached shall be damp wiped.

Note: *It might not be possible to safely reach certain areas that would pose minimal risk to future maintenance staff inside the ceiling infrastructure or patients below the ceiling plane.*

8.3.4.2.10

Immediately after a Type A activity has been completed, access panels shall be closed and displaced tiles shall be replaced.

8.3.4.2.11

All areas shall be vacuumed with HEPA filter-equipped vacuums before the next construction phase.

8.3.5 Construction Phase 4 — Final finishing

8.3.5.1 General

8.3.5.1.1

This Clause covers the construction activities from when the acoustic ceiling is installed and flooring has been completed, final duct work is completed, diffusers and millwork have been installed, to the point when the site has undergone final cleaning by the constructor.

Note: *The activities in this construction phase fall generally within Type B; however, certain jobs during this phase could require more stringent preventive measures.*

8.3.5.1.2

At the end of this stage, the constructor shall perform a final construction clean in preparation for hand-over.

Note: *An interior surface is considered reasonably visibly clean when all non-adhered substances or debris have been removed to the point where they are no longer visible to the eye. Cleaning streaks or other similar residues are not considered to be indications of an unclean surface provided that adequate cleaning has been completed. If a component is reasonably visibly clean, no further cleanliness verification methods are necessary.*

8.3.5.1.3

Non-essential construction waste materials and other non-construction related debris shall be removed from within the exterior and interior wall cavities including ceiling spaces of the HCF.

8.3.5.1.4

All vertical and horizontal surfaces that will be covered by another material, as well as all items within the work area or space that will no longer be visible, shall be cleaned using a HEPA-filtered vacuum or damp wipe methods with no solvents, or both.

8.3.5.1.5

Subsequent to the constructor's final construction clean (which shall include removal of all debris and dust associated with construction, e.g., drywall dust in cupboard spaces) and upon turnover of the building or space by the constructor, the building or space shall be in such a condition that only a terminal clean by environmental services is required. The constructor shall ensure that its cleaning responsibilities are completed prior to contacting infection control personnel for post-construction inspections. Hoarding shall be maintained until final inspection is complete.

Note: *A typical sequence for closeout and transfer would be as follows:*

a) *constructor performs final construction clean;*
b) *HCF's environmental services perform the first terminal clean of the site;*
c) *infection prevention and control personnel conduct an initial inspection before the hoarding comes down;*
d) *if the site meet inspection, hoarding is removed;*
e) *environmental services performs the final terminal clean; and*
f) *final inspection takes place.*

8.3.5.2 Dust control

8.3.5.2.1

Access to areas shall be restricted to workers required in the area.

8.3.5.2.2

Work areas shall be continuously kept free of debris and materials.

8.3.5.2.3

Work areas shall be cleaned daily and at the completion of work tasks in the space if that task is of a shorter duration. Areas with finished floors shall be HEPA vacuumed cleaned after each construction activity and wet wiped, if necessary.

8.3.5.2.4

The area shall be ventilated with the building's HVAC system.

8.3.5.2.5

Once the project has reached a semi-clean stage, separate enclosures shall be provided for activities that generate a large amount of dust (e.g., a cutting room). This space shall be isolated from the HVAC system and kept under negative air pressure via HEPA-filtered CAHUs or HEPA vacuums. Separation should be accomplished through the use of 6 mil poly, with construction air, where used.

8.3.5.2.6

A floor scrubber shall be used to clean the floors.

8.3.5.2.7

The following precautions shall be used when transporting construction materials, equipment, and debris:

a) Supplies and equipment shall be placed in clean covered or sealed containers during transportation through the HCF to prevent contamination in other areas.
b) Debris shall be placed in covered containers or covered with a clean sheet (or other type of covering material) before transporting it for disposal.

c) Exposure of the occupants of the HCF to dust and debris shall be minimized.

Note: *Debris should be removed in the evening when patients are in their rooms and visitors have left. If this is not possible, debris should be removed at the end of the workday.*

8.3.5.2.8

At the end of this construction phase a final construction clean shall be performed.

8.3.5.2.9

For areas that have reached the end of this construction phase, and prior to the start of the next phase, the following shall be performed:

a) Completed areas shall be fully isolated from any areas at an earlier construction phase.
b) Walk-off mats and boot covers shall be used at entrances to areas with finished floor installed. Mats shall be selected and maintained in accordance with Clause 6.6.1.9.
c) Access shall be limited to essential personnel only.
d) Work areas shall be cleaned immediately after the work is complete.
e) Weekly (at the minimum) cleaning of the entire area shall be performed.
f) Barrier walls shall be removed using damp wiping methods or HEPA-filtered vacuums, or both, with careful handling of materials to minimize environmental contamination (i.e., release of dust) during removal.

8.3.5.3 HVAC

The permanent air handling system shall not be used for exhausting air from the construction zone except under the following conditions:

a) The air handling system is an exhaust system that leads directly to the outdoors.
b) An engineering analysis is performed to ensure that the exhaust system continues to perform its intended function and that the operation of the HVAC system is not compromised.
c) The operation of the exhaust fan is monitored and alarmed to building operation and maintenance staff and alarmed in the construction zone.

8.3.5.4 Infection control follow-up documentation for MDT

At the end of a construction project, the constructor or the commissioning agent shall provide the MDT with written confirmation of the following:

a) the HVAC system and ducts in the construction zone are clean;
b) the HVAC system has been balanced;
c) mechanical waste disposal systems have been tested and commissioned;
d) disinfection of the plumbing system has been completed; and
e) final construction clean activities have been completed and verified.

8.3.5.5 Commissioning of HVAC systems

8.3.5.5.1

The HVAC system shall be cleaned before it is commissioned, in accordance with Clause 5.3.3.7.

8.3.5.5.2

If commissioning activities are taking place after ceiling tiles are in place, ceiling tiles or hatches may be opened for limited times (inside the areas to be occupied by general and clinical staff), provided that the following activities have taken place:

a) final construction clean has been conducted above and below the ceiling plane;

b) duct clean has taken place (if required);
c) hydronic systems have been flushed;
d) the area is isolated from other sections of the building; and
e) no work activities that generate dust are taking place in the vicinity of open ceiling tiles or hatches.

8.3.5.5.3

When commissioning of HVAC units is taking place inside mechanical rooms or on roof tops, the work shall not commence until the following activities have been performed:

a) The HVAC unit has been inspected and cleaned of any accumulated dust or moisture (especially if a thorough cleaning of the HVAC components has not previously taken place).
b) The area below or adjacent to the HVAC unit has been cleaned of dust, moisture, or standing water.

Note: *See Annex G for sample checklists.*

8.3.6 Construction Phase 5 — Completion and follow-up activities

8.3.6.1 General

8.3.6.1.1

This Clause covers any construction activities done following substantial completion and before occupancy to address project deficiencies or warranty work.

Note: *The activities in this construction phase fall generally within Type A; however, certain jobs during this phase could require more stringent preventive measures.*

8.3.6.1.2

Before substantial completion and occupancy, the constructor shall obtain an infection control deficiency checklist from the project team and, once all checklist items have been satisfied, have the completed deficiency work inspected by the consultant. Detailed inspections shall be performed to confirm that all checklist items have been satisfied.

Note: *See Annex G for examples of checklists.*

8.3.6.1.3

Before the completed construction area is occupied, any portions of the infection control plan still in effect shall be reviewed and approved by the MDT and by the ICP as needed. The MDT shall incorporate such applicable portions of the infection control plan into the HCF's ongoing operating policies and procedures.

8.3.6.2 Dust control

8.3.6.2.1

Dust control shall be performed in accordance with Clause 7 and facility policy for occupied areas.

8.3.6.2.2

A preventive measures analysis shall be performed by the constructor on each dust-generating activity or group of similar activities. The preventive measures analysis shall be reviewed and approved by the MDT, and by the ICP as needed, prior to commencing those tasks. Activities calling for PM I or II shall be undertaken with coordination of users.

8.4 After construction

8.4.1 Preventive measure I

Following substantial completion of the project, the MDT shall review the preventive measures that were undertaken and assess their effectiveness.

8.4.2 Preventive measures II and III

8.4.2.1

The MDT shall

a) review the preventive measures that were undertaken and assess their effectiveness; and
b) conduct a final inspection to ensure that the ventilation system is clean and is functioning properly in the construction area and adjacent areas.

Note: *The inspection in Item b) should be coordinated with the commissioning team for the HCF.*

8.4.2.2

The project team shall ensure that the construction area has been thoroughly cleaned if change order or deficiency work is considered before final inspection and takeover by the owner. The MDT shall confirm that this has been performed.

8.4.2.3

Infection prevention and control personnel shall ensure that the construction area has been terminally cleaned before building occupants are allowed to occupy the new space. The terminal cleaning shall be performed by the HCF environmental services department or designated alternate cleaning contractor with terminal cleaning procedures approved by the MDT.

8.4.3 Preventive measure IV

The requirements specified in Clauses 8.4.1 and 8.4.2 shall be met. In addition, before the completed construction area is occupied, any portions of the infection control plan still in effect shall be reviewed by the MDT, and by the ICP as needed. If necessary, such portions shall be incorporated into the HCF's ongoing operating policies and procedures.

8.4.4 Infection control procedures quality review

At the end of the project, the project team including the MDT shall conduct an infection control procedures quality review.

Note: *The review is intended to determine what was successful in the process and where improvements could be made in future projects. The focus should be on strengths and weaknesses of the procedures used, rather than individual performance. Sample questions may include the following:*

a) *During the planning, design, and construction of the HCF, which strategies or portions of the infection control plan worked very well and might have exceeded expectations?*
b) *During the planning, design, and construction of the HCF, which strategies or portions of the infection control plan did not perform well and might have performed below expectations?*

These items should be recorded and brought forward to future projects by all or individuals.

9 Remedial measures

9.1 General

During construction or routine maintenance, events can occur in which immediate intervention is necessary to limit damage and reduce the risk of environmental contamination by micro-organisms. Procedures shall be in place to assist staff responding to these events.

9.2 Water leaks and flooding

Water leaks and flooding shall be reported immediately to

a) the managers of the affected areas, who shall be responsible for protecting building occupants or removing them from the affected areas;
b) HCF operation and maintenance staff, who shall be responsible for
   i) defining, locating, and controlling the source of the leaks or flooding;
   ii) recording the extent of water damage to structures, materials, and furniture; and
   iii) implementing and monitoring remedial measures; and
c) the site MDT, who shall be responsible for managing infection risks, and providing advice to the project team on remedial measures.

9.3 Investigation

9.3.1

If water damage is detected, there shall be a thorough investigation of all damaged areas by trained operation and maintenance staff or accredited consultants.

Note: *This is particularly important if it is possible that long-term damage has occurred.*

9.3.2

All concealed spaces (e.g., above ceilings, behind walls, and below floors) in the affected areas shall be inspected to determine the extent of damage and moisture penetration. A moisture meter shall be used to test porous materials for the extent of water invasion.

9.3.3

If moisture penetration is detected within 48 h, staff shall proceed with the measures specified in Clause 9.5. If moisture penetration has been undetected or ignored for over 48 h, the abatement measures in Clause 9.6 shall be instituted.

9.3.4

Mould-affected areas can be classified as follows:

a) Level 1: small area, less than 1 m^2;
b) Level 2: medium-size area, 1 to 3 m^2;
c) Level 3: large area, greater than 3 m^2 to 10 m^2;
d) Level 4: extensive contamination of an area greater than 10 m^2 or numerous areas; and
e) Level 5: HVAC or domestic water systems contamination in any affected area.

Note: *Remediation standards classify mould-affected areas in different ways (e.g., areas classified as Levels 2 or 3 in this Standard both fall under Level II in CCA 82.*

9.4 Containment of contaminants

9.4.1
All investigations and removal and abatement procedures shall be conducted in a manner that does not promote dispersal of dust and spores or generate aerosols from water sources. There shall be a check of the building hazardous materials manifest for asbestos and lead containing materials before starting removals.

9.4.2
A dust suppression method (e.g., misting) shall be used before contaminated materials are removed or disturbed. Attention shall be given to electrical safety concerns when misting.

9.4.3
Ductwork, diffusers, and all openings in the construction area shall be sealed or capped dust tight. All work areas within an enclosure shall have negative air pressure provided by CAHUs. Ventilation systems shall be configured to create negative pressure in the contaminated area.

Note: *It is possible that additional equipment (e.g., portable exhaust fans or HEPA filter-equipped air cleaners) will be required during peak contamination periods.*

9.4.4
The contaminated areas shall be physically separated from uncontaminated areas by closing and sealing all openings (e.g., openings for doors and windows). If an opening is not already connected to an object that can seal it (e.g., a door), an impermeable dust barrier shall be constructed.

9.4.5
All personnel involved with or exposed to contaminated materials shall be equipped with protective clothing and safety apparatus consistent with occupational health and safety requirements.

9.4.6
All personnel involved with or participating in the implementation of remedial measures shall take appropriate measures to avoid the spread of contaminants when leaving affected areas (e.g., removal of protective clothing and washing or wiping of boots, equipment, and tools).

9.5 Corrective measures

9.5.1
In cases where bacterial contamination or mould growth has not been detected and only moisture damage has occurred, immediate action shall be taken to prevent further problems. Assessment, mitigation, material removal, in-place drying, and restoration methods shall be conducted in a manner consistent with ANSI/IICRC S500.

9.5.2
Cellulose fibre-based and porous materials (e.g., acoustic ceiling tiles, gypsum wallboard, carpet, and fabrics) shall be assessed, and if found to be moist, they shall be dried or removed as necessary. If there is a question whether or not to remove materials, a risk assessment shall be used that takes into account the patient population and the expected use of the space. Materials that are supporting mould growth shall be discarded and replaced.

Because mould can rapidly appear on cellulose and fibre-based materials, such materials shall be replaced if they have been wet for more than 48 h or have had multiple exposures to moisture.

9.5.3

Water-damaged materials or material affected by mould shall not be enclosed or spray encapsulated.

Note: *The only generally recognized way to remediate biologically contaminated materials is through source removal.*

9.5.4

Non-removable materials shall be dried in-place using water extraction, absorbent materials, mechanical dryers, and air movers in a manner consistent with ANSI/IICRC S500. The MDT shall ensure that the means used for drying does not create an infection risk to patients through the movement of air and dust from the remediation site.

9.5.5

In all cases of moisture damage, the underlying cause, or causes of moisture damage shall be corrected to prevent future water damage and mould growth.

9.5.6

Individuals conducting assessments, mitigation, material removal, in-place drying, and restoration shall be adequately trained and qualified to do this work.

Note: *Qualification of personnel should be documented though a formal certification program under a recognized organization, e.g., certification as a water restoration technician (WRT) through the IICRC.*

9.6 Abatement measures

9.6.1

A plan of abatement measures for the contaminated areas shall be prepared in a manner consistent with currently accepted protocols (e.g., CCA 82, the New York City Department of Health's *Guidelines on Assessment and Remediation of Fungi in Indoor Environments*, or ANSI/IICRC S520 and ANSI/IIRC R520).

Note: *The abatement measures and procedures prescribed by the above mentioned guidelines/standards are designed to protect healthy workers and building occupants and are not necessarily adequate by themselves to protect immunocompromised individuals. When developing an abatement plan, care should be taken to ensure compliance with the above mentioned documents and this Standard.*

9.6.2

The work shall be performed by a qualified abatement contractor or by qualified operation and maintenance staff adequately trained in abatement protocols.

Note: *Qualification of personnel should be documented though a formal certification program under a recognized organization, e.g., certification as an applied microbial remediation technician (AMRT) by the IICRC.*

9.6.3

Contaminated materials shall be removed in a manner that limits dust generation and the release and migration of mould and bacteria.

9.6.4
Removed facility materials shall be wrapped with a minimum 6 mil layer of polyethylene and sealed with tape or placed in a suitable air tight sealed container, and discarded unless effective cleaning and disinfection can be performed.

9.6.5
Non-removable facility materials shall be thoroughly cleaned by vacuuming with a HEPA filter-equipped vacuum cleaner followed by scrubbing with a detergent solution.

9.6.6
All surfaces and materials adjacent to the affected area shall be thoroughly vacuumed with a HEPA filter-equipped vacuum cleaner and damp wiped with a mild detergent. The MDT shall assess if the application of a disinfectant, sanitizer, or sterilizer to adjacent materials is necessary.

9.6.7
If investigation determines that there is a risk of contamination, the air ductwork to and from the affected area shall also be vacuumed with a HEPA filter-equipped vacuum cleaner and damp wiped. All downline filters shall be replaced.

9.7 Inspection of remediated areas

9.7.1
All areas (including those concealed behind walls and ceilings) shall be thoroughly inspected before they are made available again for use by patients and staff.

9.7.2
Clearance air samples shall be taken in Level 4 and 5 mould-affected areas (see Clause 9.3.4). This testing shall be performed and interpreted by an environmental consultant or company that is qualified to do environmental testing.

9.7.3
Surfaces shall be retested with a moisture meter to determine that drying is complete (completeness shall be determined by reference to a control area in the facility).

Table 1
Preventive measures analysis
(See Clauses 3.1, 6.5.1, 6.5.2, 7.1, 7.2.4.2, 7.5.3.1.)

Population risk group (from Table 2)	Construction activity type (from Table 3)			
	Type A	Type B	Type C	Type D
Group 1	I	II*	II	III/IV
Group 2	I	II*	III	IV
Group 3	I	III*	III/IV	IV
Group 4	I–III	III/IV*	III/IV	IV

* *Denotes where a lower level might be used in accordance with Clause 7.5.*

Note: *Instructions for this Table:*

a) *Refer to Table 2 to determine the population risk group.*

b) *Refer to Table 3 to determine the construction activity type.*

c) *The intersection between the row (risk group) and column (activity type) shows the preventive measure level that applies.*

d) *Where this Table offers a range instead of a single level, the appropriate preventive measure shall be determined as follows:*

   i) *When the preventive measure is shown as I–III (Population Risk Group 4, Construction Activity Type A), the infection prevention and control department shall be consulted to determine the appropriate preventive measure (I, II, or III).*

   ii) *When the preventive measure is shown as III/IV (four other places in the Table), the MDT shall determine the appropriate level (see Clause 7.2.4.2).*

e) *Clause 7.5 offers practical exceptions for short-term projects involving only ceiling access for investigation or minor work, provided that appropriate precautions are used.*

Table 2
Population risk groups and geographical areas
(See Clauses 5.3.2.4, 6.3.8.1, 6.5.2, 7.3.3.5, and 8.3.1.2.6 and Table 1.)

Population risk group	Typical areas
Group 1 Lowest risk	Office areas (i.e., non-clinical)
	Unoccupied patient care units
	Public areas not intersecting a patient care area
	Laundry and soiled linen sorting or storage areas
	Physical plant workshops
	Housekeeping rooms and closets
Group 2 Medium risk	Patient care areas, unless listed in Group 3 or Group 4
	Outpatient clinics (except oncology and surgery)
	Admission and discharge units

(Continued)

Table 2 (Continued)

Population risk group	Typical areas
	Waiting rooms
	Autopsy and morgue
	Occupational therapy and physical therapy areas remote from patient care areas
Group 3 Medium to high risk	Emergency (except trauma rooms)
	Diagnostic imaging
	Labour and birthing rooms (without operating room capability)
	Nurseries for healthy newborns
	Nuclear medicine
	Hydrotherapy
	Echocardiography
	Laboratories
	General medical and surgical wards or units (includes all areas including soiled and clean utility rooms)
	Pediatric units
	Geriatric units
	Long-term care units
	Food preparation, serving, and dining areas
	Respiratory therapy
	Clean linen handling and storage areas
Group 4 Highest risk	Intensive care units (ICU, PICU, NICU, etc.)
	Operating rooms (including prep, induction, post-anaesthetic care unit (PACU), and scrub areas)
	Anaesthesia storage areas and workrooms
	Oncology units and outpatient clinics
	Transplant units and outpatient clinics
	Inpatient units and outpatient clinics for patients with AIDS or other immunodeficiency diseases
	Dialysis units
	Critical care nurseries
	Labour and delivery operating rooms

(Continued)

Table 2 (Concluded)

Population risk group	Typical areas
	Interventional or high-risk diagnostic imaging, e.g., • Cardiac catheterization and angiography • Interventional radiology • Endoscopy • Bronchoscopy • Cystoscopy
	Cardiovascular and cardiology patient areas
	Pharmacy admixture rooms
	Medical device reprocessing areas (wherever located)
	Central sterile supply
	Clean and sterile storage
	Burn care units
	Animal rooms
	Trauma rooms
	Protective isolation rooms
	Tissue culture laboratories
	Pacemaker insertion rooms
	Dental procedure rooms

Table 3
Construction activity type
(See Clauses 3.1, 6.3.8.1, 6.5.2, and 7.5.3.1 and Table 1.)

Construction activity type	Description
Type A	Inspection and non-invasive activities. These include, but are not limited to, a) activities that involve a single controlled opening in a wall or ceiling for minor work or visual inspection, that is accessed by i) removing no more than one ceiling tile; or ii) opening of an access panel on a wall or ceiling; b) painting (but not sanding) and wall covering; c) electrical trim work; d) minor plumbing work that disrupts the water supply to a localized patient care area (i.e., one room) for less than 15 min; and e) other maintenance activities that do not generate dust or require cutting of walls or access to ceilings, other than as specified in Item a).
Type B	Small-scale, short-duration (e.g., less than 2 h) activities that create minimal dust. These include, but are not limited to, a) activities involving access to and use of chase spaces; b) cutting a small opening in a contained space where dust migration can be controlled, e.g., cutting of walls or ceilings to provide an access point for installing or repairing minor electrical work, ventilation components, telephone wires, or computer cables; c) sanding or repair of a small area of a wall; and d) plumbing work that disrupts the water supply of one or more patient care areas for less than 30 min.
Type C	Activities that generate a moderate to high level of dust, cause a moderate service disruption, require demolition, require removal of a fixed facility component (e.g., a sink) or assembly (e.g., a countertop or cupboard), or cannot be completed in a single work shift. These include, but are not limited to, a) activities that require sanding of a wall in preparation for painting or wall covering; b) removal of floor coverings, ceiling tiles, and casework; c) new wall construction; d) minor ductwork; e) electrical work above ceilings; f) major cabling activities; and g) plumbing work that disrupts the water supply of one or more patient care areas for more than 30 min, but less than 1 h.
Type D	Activities that generate high levels of dust, activities that necessitate significant service disruptions, and major demolition and construction activities requiring consecutive work shifts to complete. These include, but are not limited to, a) soil excavation; b) new construction that requires consecutive work shifts to complete; c) activities that involve heavy demolition or removal of a complete cabling system; or d) plumbing work that disrupts the water supply of more than one patient care area (i.e., two or more rooms) for 1 h or more.

Table 4
Time required for airborne contaminant removal at 99.9% efficiency
(See Clause 6.6.1.6.)

Air changes per hour (ACH) *	Time, *T*, required for removal, min†
	99.9% efficiency
2	207
4	104
6‡	69
8	52
10‡	41
12‡	35
15‡	28
20	21
50	8

* $ACH = Q/V$
where
Q = air flow rates, m^3/h
V = room volume, m^3
† *Values have been derived from the following formula:*
$T = t_2 - t_1 = -[\ln (C_2/C_1)/(ACH)] \times 60$
where
t_1 = initial timepoint, min = 0
t_2 = final timepoint, min
C_1 = initial concentration of contaminant
C_2 = final concentration of contaminant
$C_2/C_1 = 1 - (\text{removal efficiency}/100)$
Values apply to an empty room with no aerosol-generating source. This Table does not apply when a person is present and generating aerosol. Other equations are available that include a constant generating source. However, certain diseases (e.g., infectious tuberculosis) are unlikely to be aerosolized at a constant rate. The times given assume perfect mixing of the air within the space (i.e., mixing factor = 1). For booths or other local ventilation enclosures, the manufacturer's instructions should be consulted.
‡ *Frequently cited ACH for patient care areas.*

Notes:

1) *This Table has been adapted from Table B.1 of the U.S. Department of Health and Human Services* Guidelines for Environmental Infection Control in Health-Care Facilities*.*

2) *The times noted in this Table are based on the above conditions. As construction zones rarely meet these restrictions, appropriate factors of safety as determined by a knowledgeable individual shall be applied when using this Table. Factors of safety ranging from 2 to 5 are common for renovation spaces within existing buildings.*

3) *Perfect mixing usually does not occur. Removal times will be longer in rooms or areas with imperfect mixing or air stagnation. Caution should be exercised in using this Table for such situations.*

Annex A (Informative)
Multidisciplinary team — Sample terms of reference

Note: *This Annex is not a mandatory part of this Standard.*

General information:

Date of this document: _____

Version: _____

Health care facility: _____

Project (if applicable): _____

Project dates (if applicable): _____

Meeting frequency: _____

Membership:

□ Planning department:_____

□ Infection prevention and control:_____

□ Facilities management:_____

□ Environmental services:_____

□ Employee wellness and safety:_____

□ Ex officio members:_____

□ Hospital architect:_____

□ Local contractor:_____

□ Clinical representative:_____

□ Administration representative:_____

Reporting relationship:

Committee reports to the _____ (e.g., Director Project Planning) and takes guidance from _____ (e.g., HCF Administrator)

MDT purpose:

a) Ensure that infection prevention and control requirements are followed on all construction projects in accordance with the most recent edition of this Standard.
b) Establish site-specific risk management strategies and review contractors' infection control plans to ensure that construction activities do not cause or spread infection to patients, HCF staff, and families.

MDT responsibilities:

a) Participate and be a resource for the planning and design of renovation and construction project infection control components when the work requirements have a standards or statutory requirement review necessary to be in compliance.
b) Work with project management and infection prevention and control staff to establish, for each minor and major project, an infection control risk analysis based upon
   i) the risk group (1,2,3, or 4);
   ii) the construction activity type (A, B, C, or D); and
   iii) the appropriate preventive measure (I, II, III, or IV).
c) Complete the "Infection control preventive measures analysis form" (see Annex C for a sample) All infection control preventive measures analysis forms are sent to the chair of the committee for review at the next regular meeting.
d) Recommend risk management strategies to hospital redevelopment department and project architects for the planning and design of projects as per the ICRA forms. Strategies can include
   i) phasing of the work;
   ii) dust barriers and daily contractor maintenance and record keeping requirements;
   iii) pressurization of areas at higher risk;
   iv) contractor access to the place of work for staff and materials;
   v) demolition times;
   vi) departments adjacent to the place of work that could be impacted;
   vii) removal methods of demolition material;
   viii) contractor access into other areas of the hospital for mechanical, plumbing, and electrical coordination work;
   ix) elevator access for either incoming materials or outgoing demolition debris;
   x) relocation of high-risk patients in proximity to the planned place of work;
   xi) mandatory notification of demolition work with specific room numbers to the hospital protection services department so that smoke detectors can be temporarily disabled;
   xii) hazardous materials surveys or confirmations of site building hazardous materials reports prior to construction;
   xiii) awareness training of contractor's site superintendents in infection prevention and control; and
   xiv) material storage requirements on site.
e) Review work practices from the operation and maintenance department where potential infection control issues could arise during operations.

Additional designated responsibilities

The HCF project manager will

a) ensure that start-up and ongoing construction site meetings are scheduled as required or for all Risk Group Level 3 and 4 projects to ensure design of the project incorporates infection prevention and control components;
b) ensure the infection control preventive measures analysis actions are incorporated into the project plan, scope of work, and tender drawings and specifications to contractors; and
c) monitor the project and report any significant infection control issues to the committee.

Members of the committee will regularly visit the place of work for inspections, coordination activities, or meetings.

Members of the committee will work closely with the HCF project manager and construction site supervisor.

When a project is deemed to be a Preventive Measure III or IV, the project manager will ensure that a site review is completed with infection control and reviewed with the committee before occupancy of staff and patients.

Authorization:

Name: _____

Title: _____

Signature: _____

Date: _____

Annex B (informative)
Infection prevention and control professional

Note: *This Annex is not a mandatory part of this Standard.*

B.1 General

As a member of the MDT, the infection prevention and control professional (ICP) has a number of responsibilities, as specified in this Annex. There may be more than one ICP on a team.

ICPs who have a role in construction projects affecting their HCF should be qualified by having taken a recognized course in infection control during construction, renovations, and maintenance. Other courses such as a general construction safely course can also be valuable.

B.2 Communication

B.2.1

In the planning phase of a construction or renovation project, the ICP can help establish clear lines of communication between all personnel involved in the project by ensuring that an effective communication plan is followed throughout the project.

B.2.2

The ICP should prepare for effective involvement in the construction project by becoming familiar with the capital planning process for HCFs and knowing the key individuals and their roles.

B.3 Establishing guidelines

The ICP can be instrumental in establishing guidelines for all facility staff pertaining to the following construction-related concerns:

a) Traffic control:
   i) In collaboration with the facility project manager, the ICP can designate a traffic pattern for construction workers that avoids patient care areas and a traffic pattern for moving clean or sterile supplies and equipment that avoids the construction area.
   ii) The ICP can help medical or nursing staff ensure that patients do not go near the construction area.
b) Environmental cleaning procedures: In collaboration with the environmental services staff, the ICP can make recommendations on the cleaning procedures that should be used in areas adjacent to the construction area.

B.4 Education

B.4.1

The ICP plays a major educative role by

a) providing scientific evidence that life-threatening infections in patients could be the result of improperly contained construction activities;
b) sharing evidence that properly contained construction activities should not increase the risk of infection;
c) acting as a role model by wearing the appropriate safety equipment when visiting the construction area; and

d) providing or arranging for continuing education.

B.4.2
The ICP can educate administrators on infection control concerns and the importance of preventive measures.

B.4.3
The ICP should develop a close working relationship with the facility project manager and educate him or her on infection control concerns and the importance of preventive measures.

B.4.4
Through education, the ICP can ensure that committee members understand the risks and respond with appropriate measures. Changes to the preventive measures should be made only after approval by the ICP.

B.5 Risk assessment

B.5.1
The ICP should be involved in the risk assessment and reduction process. These activities may include
a) collaborating with the health care staff to identify high-risk patients and the appropriate preventive measures to ensure their safety;
b) conducting routine *Legionella* surveillance before, during, and after construction; and
c) moving high-risk patients who are in or adjacent to the construction area.

B.5.2
The ICP should help promote awareness of the potential danger to high-risk populations posed by any type of construction activity (even seemingly minor tasks such as drilling holes in walls), so that constructors routinely inform infection prevention and control staff of any planned project that could affect patient care areas.

B.6 Surveillance and evaluation
The ICP should regularly visit the construction area with the facility project manager to ensure that preventive measures are being adhered to and that appropriate modifications are made if there are any on-site design changes. The ICP should ensure that the construction area is thoroughly cleaned when work is complete and check the area before patients are readmitted. Any concerns should be shared with the environmental services department and the facility project manager.

Surveillance should augment preventive strategies during construction, renovation, and maintenance projects. By determining baseline levels of health care-acquired airborne and waterborne infections, the ICP can monitor changes in infection rates and patterns during and immediately after construction, renovations, or maintenance/repairs.

B.7 Documentation
The ICP should document surveillance data collected before, during, and after the project and share that data with the appropriate members of the MDT. The surveillance data should be retained in the project records.

Annex C (informative)
Preventive measures analysis

Note: *This Annex is not a mandatory part of this Standard.*

Preventive measures analysis form

This form is non-mandatory and may be used to complete the preventive measures analysis forming part of the ICRA. Clause 6.5.4 requires completion of a similar preventive measures analysis document prior to Level III and IV work.

Project name:	
Project start:	
Project completion:	
Project manager:	
Project location:	
Multidisciplinary team (MDT):	
MDT leader:	

A preventive measures analysis of the construction or renovation project described below has been undertaken in accordance with CSA Z317.13 and incorporated into the project design development contract which includes drawings and specifications.

Brief description of construction or renovation project (including activities involved):

Preventive measures analysis:
Population risk group of construction area (1, 2, 3, or 4):
Area above construction space:
Area below construction space:
Area laterally adjacent to construction space:
Other areas impacted (e.g., connected by ducts, conduit, other means):
Construction activity type (A, B, C, or D):
Preventive measure (I, II, III, or IV):

Additional requirements (include additional information or drawings as necessary):

MDT signature:	Date:
Project manager signature:	Date:

Annex D (informative)
Sample table of contents for an infection control plan

Note: *This Annex is not a mandatory part of this Standard.*

1. Introduction
- Plan overview
- Purpose of the plan
- Objectives
- Scope

2. Standards, criteria, additional references
- References to CSA Group Standard(s)
- Additional References

3. Definitions and abbreviations

4. Key responsibilities
- Constructor/prime contractor/design builder
- Constructor project representatives
- Construction/project managers, site superintendent(s)
- Plan administrator
- Industrial hygienist (infection control specialist)
- Health care facility staff (medical/nursing)
- Health care facility – Facilities, maintenance, and operations (FM&O)
- Site joint health and safety committee
- Assistant superintendents/foremen
- Safety personnel (e.g., CSO, project safety coordinator)
- Workers
- Subcontractors
- Construction material suppliers
- Visitors, other suppliers, consultants

5. Communication and reporting
- Project organizational chart
- MDT members
- Reporting requirements and protocols
- Reporting hierarchy
- Communication means and methods
- Non-compliance/disciplinary action

6. Risk identification, factors, and assessment
- Risk factors
- Risk groups
- Contamination/infection sources
- Contamination factors
- Infection control risk assessments (preventive measures analysis)

7. Risk prevention measures and controls
- Proper material handling

- Dust control measures
- Additional/related controls

8. Monitoring requirements
- IPAC workplace site inspections
  - Daily
  - Weekly
  - Monthly
- Air monitoring

9. Worker education and training
- Overview
- Minimum requirements
  - CSA Group Standard training (2 days)
  - Site orientation/training
  - Modified site orientation/training
- Frequency/intervals
- Records

10. Subcontractor and supplier management
- Subcontractors
- Construction material suppliers

11. Plan maintenance and review
- Overview
- Involved personnel
- Primary review requirements
- Additional reviews

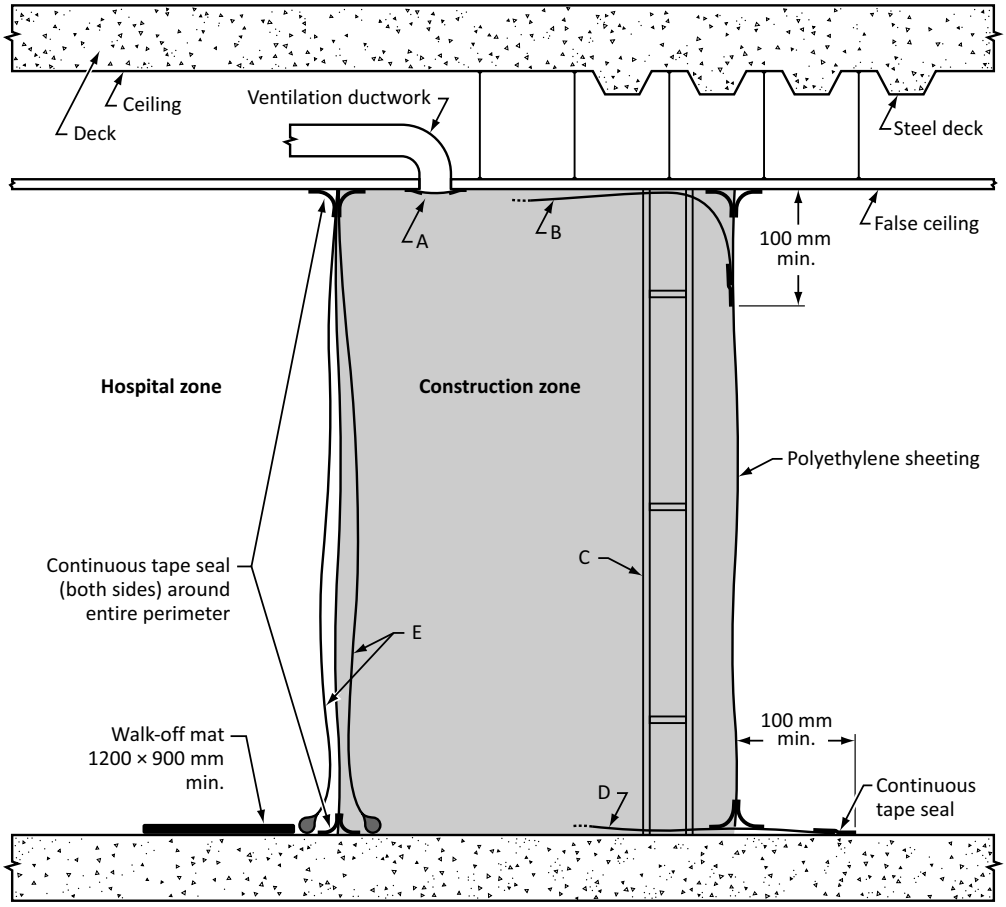
12. Document and record maintenance

13. Plan sign offs
- Workers, site personnel
- Subcontractors
- Project Co./authority/MDT Members

Annex E (informative)
Examples of barrier configurations

Note: *This Annex is not a mandatory part of this Standard.*

Figure E.1
Preventive measure II infection control dust barrier, elevation view
(See Clause 7.3.2.2.)



Legend:

A = Windows, doors, shafts, access panels, electrical outlets, intakes, grilles, exhausts, vents, plumbing drains, and all other penetrations in the floor, walls, and ceilings are sealed.

B = Textured, perforated, or drop ceilings are covered with polyethylene to be placed on the inside of vertical sheeting and taped with a continuous seal. Work above the false ceiling requires a barrier extending to the true ceiling.

C = Polyethylene sheeting is reinforced where necessary with framing (metal or wood), zip wall poles, or schedule 40 PVC piping.

D = Carpeted or textured floors have polyethylene sheeting of a minimum 12 mil thickness or two 6 mil sheets one on top of the other. Vertical sheeting overlaps the horizontal base sheet of polyethylene.

E = Double-flap polyethylene sheeting of a minimum true 6 mil thickness weighted at the bottom. Each door covers the entire cross-section of entrance to work area and opens in both directions.

Figure E.2
Preventive measure II infection control dust barrier, plan view
(See Clause 7.3.2.2.)

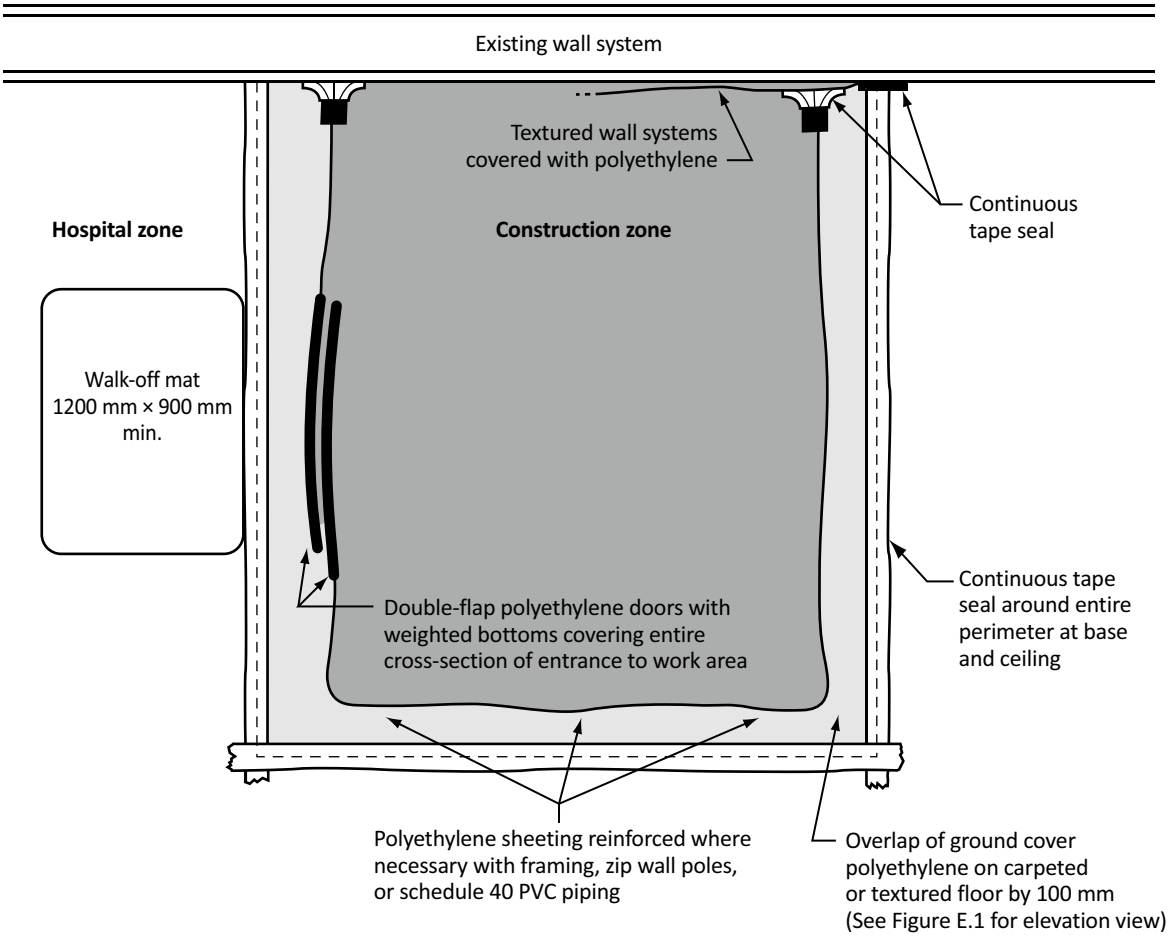
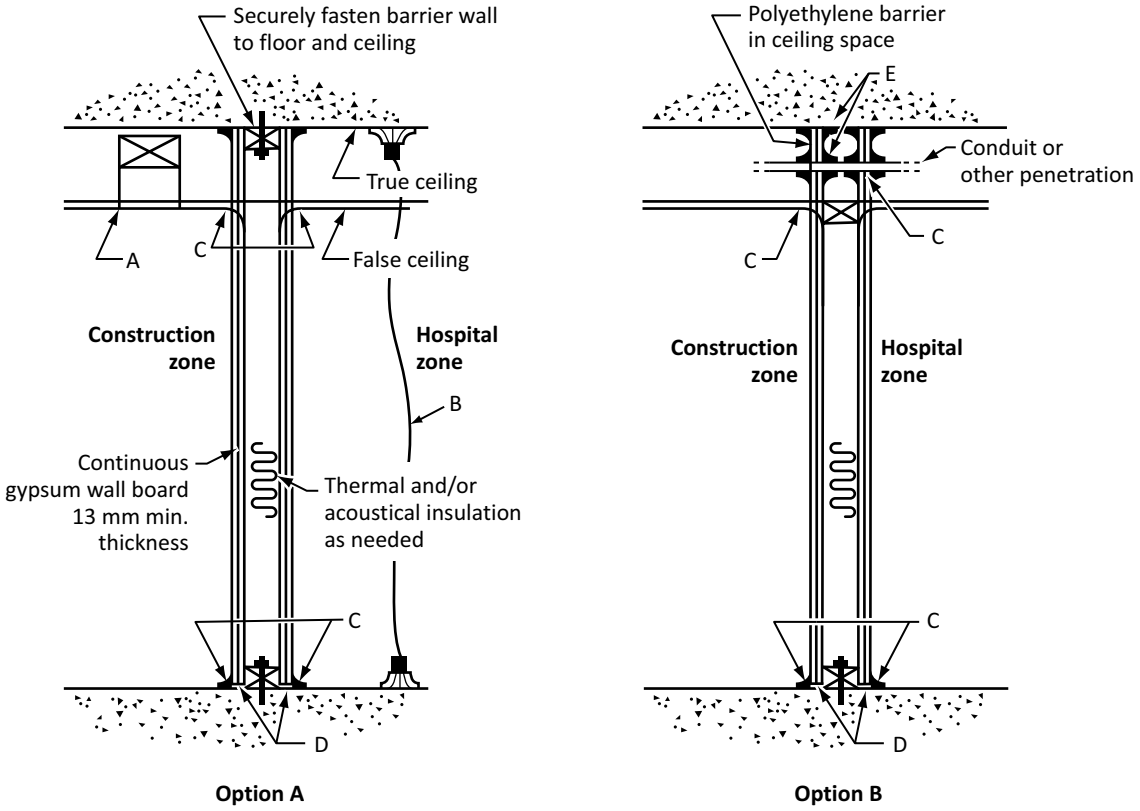


Figure E.3
Preventive measures III and IV infection control dust barrier wall details, elevation view

(See Clauses 7.3.3 and 7.3.4.)



Legend:

A = Windows, doors, shafts, access panels, electrical outlets, intakes, grilles, exhausts, vents, plumbing drains, and all other penetrations in the floor, walls, and ceilings are sealed.

B = Continuous polyethylene sheeting wall, minimum 6 mil thickness, extending from the true ceiling to the floor and around the entire perimeter of the construction zone.

C = Continuous tape seal of gypsum wallboard to floor and ceiling. Entire perimeter is sealed.

D = Continuous tape seal of polyethylene to floor and ceiling. Entire perimeter is sealed.

E = Continuous tape seal of both sides of polyethylene. Entire perimeter is sealed.

Notes:

1) *Option A is preferred. Option B should be used only when penetrations, utilities, or the ceiling structure do not permit extension of a full dust barrier wall.*

2) *A negative pressure of 7.5 Pa is maintained within the construction zone.*

3) *Gypsum wallboard is installed with a gap of no less than 7 mm between the bottom edge and the floor to prevent wicking of spilled or flooded water.*

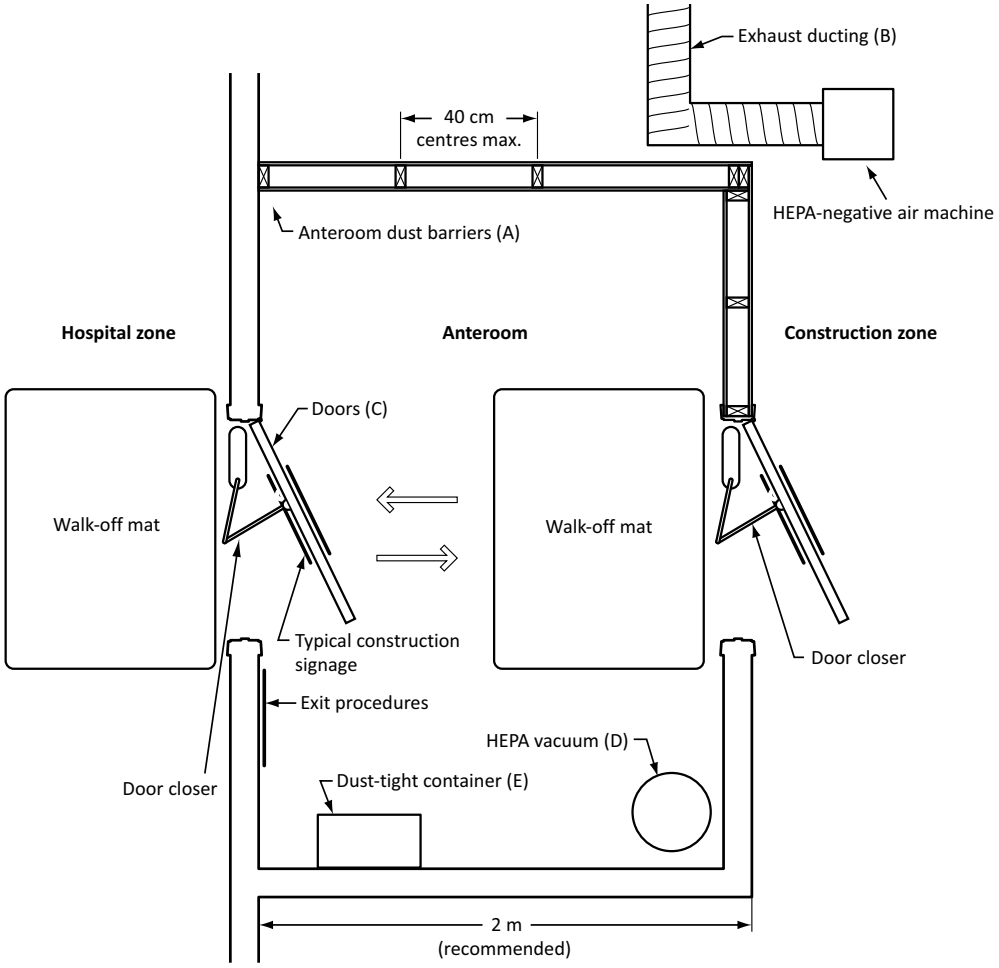
4) *Wall construction comprises 92 mm deep metal studs on 13 mm gypsum wallboard (both sides).*

5) *Tape can be installed with adhesive spray.*

6) *All materials should be kept dry throughout the project.*

7) *The surface closest to the hospital zone is the wipeable surface.*

Figure E.4
Preventive measure IV infection control dust barrier anteroom, plan view
(See Clauses 6.6.1.9 and 7.3.4.)



Legend:

A = Anteroom dust barriers extend to the true ceiling or have their roofs constructed in the same manner as PM III barriers (see Clause 7.3.3.2). The roof needs to be constructed in a manner that protects against overhead hazards.

B = Exhaust ducting is exhausted to the exterior of the building and directed away from air intakes, occupied areas, or other building openings.

C = Hollow metal lockable doors. Frame and bottom sealed with weatherstripping.

D = Assigned and dedicated HEPA vacuum for personal decontamination and daily or more frequent (if needed) cleaning of anteroom.

E = Dust covers, body suits, and dust masks (for visitors only) hung at wall in a covered dust-tight container.

Notes:

1) *Ceiling height should allow space for the manipulation of construction materials coming through the anteroom. A 2.5 m height is recommended.*

2) *The anteroom is the only means of entering and exiting the construction zone. It should be large enough to accommodate the materials that will be moved through it. If both doors must be open to accommodate large items passing through, this should be done under controlled conditions.*

Figure E.5
Preventive measures III and IV infection control dust barrier door details, elevation view
(See Clauses 7.3.3 and 7.3.4.)

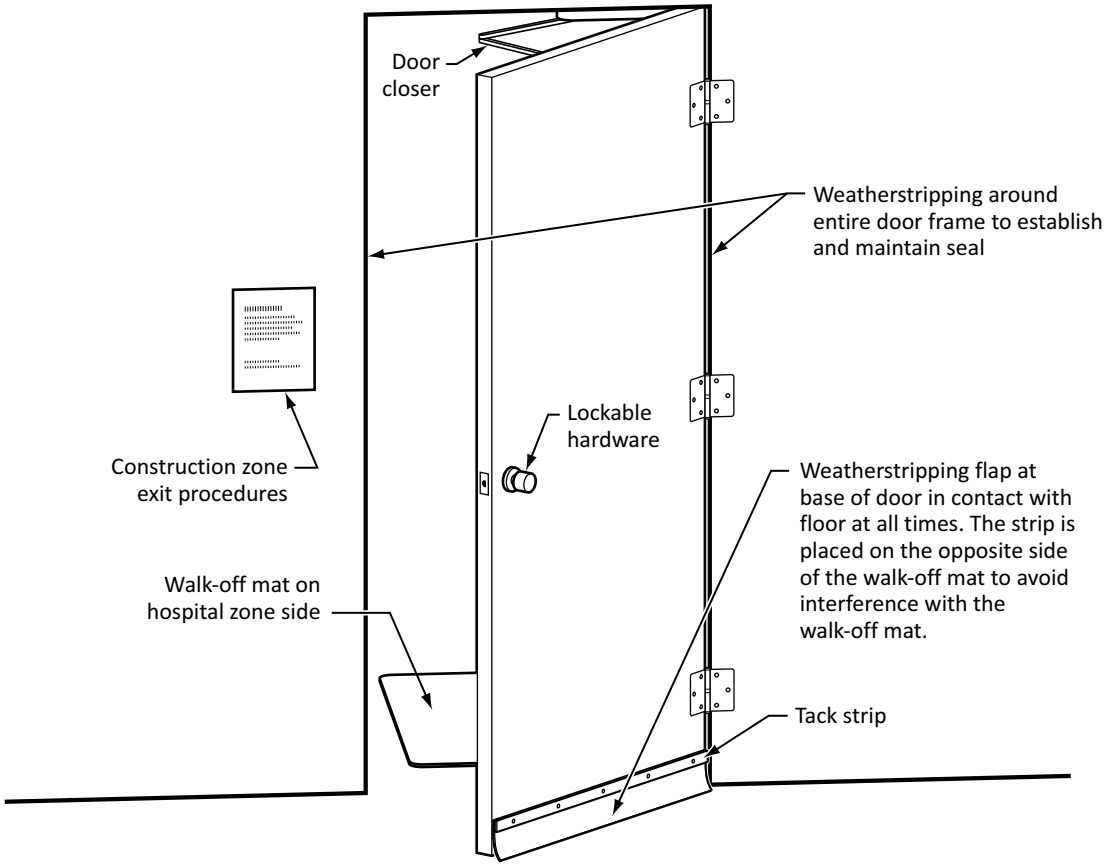


Figure E.6
Preventive measures II to IV infection control dust barrier signage
(See Clauses 7.3.2.2 and 7.3.3.)

Annex F (informative)
Sizing of HEPA-filtered construction air handling units (CAHUs)

Note: *This Annex is not a mandatory part of this Standard.*

F.1 General

This Annex is provided as an example of calculations used to size HEPA-filtered CAHUs. There are several variables that will affect the size of CAHUs to be used on any given project and this Annex is intended only to provide general guidance. Past experience within any given facility is the best indicator of CAHU sizing requirements; however, calculations can be used to determine an appropriate order of numbers and sizes of units that may be appropriate.

Note: *Many manufacturers' web sites have calculators.*

F.2 Variables affecting sizing requirements

F.2.1 Length of exhaust

CAHU size is dependent on the placement of the CAHUs and the distance between the CAHU location and the point of discharge air. Longer lengths of discharge ducting require larger or more efficient fans to overcome the static pressure developed through the discharge ductwork. In addition, the type of ducting use can influence fan sizes. Smoother, rigid ductwork creates less turbulence than some of the flexible spiral reinforced, or collapsible ductwork and may be more appropriate for long distances between the CAHU and the discharge location.

Duct geometry (i.e., the number of bends and the angle of the bends) can also create additional restriction to airflow and could increase the size of CAHUs. As a rule of thumb, exhaust ductwork from CAHUs is better served if the bends are restricted to 45° or less. In cases where exhaust ductwork must travel very long distances, booster fans may be employed along the exhaust ductwork route to improve CAHU efficiency. Where HEPA filtration already exists within the CAHUs, booster fans need not be equipped with HEPA filtration.

F.2.2 Barrier tightness

The size of the CAHU is dependent on the aggregate area of openings in the barrier walls. When constructors take care to seal potential openings in the walls, CAHUs become more efficient. Techniques such as taping all openings, using foam gaskets between barrier walls and permanent walls, or sealing over openings through existing walls (e.g., light switches or electrical outlets) when using existing walls as barriers, all increase the effectiveness of the CAHUs.

F.2.3 Room volume

The total volume of space to be drawn under pressure impacts on the size of the CAHUs. When calculating the size of the space, users should always consider any space that may not be sealed and considered to be within the construction. Areas such as ceiling cavities above T-bar ceilings or mechanical/electrical chases that may become pressurized during the construction should be considered when calculating the volume of space to be pressurized by the CAHUs.

F.2.4 Air exchange rate

Most jurisdictions have a minimum air exchange rate in work spaces for worker safety. However, this minimum air exchange rate is rarely sufficient to reach the 7.5 Pa specified with this Standard. In many renovation projects, air exchange rates of between 4 and 6 ACH can be satisfactory to produce the required differential pressure depending on the other variables noted within this Annex. In cases where PM III or IV is employed, constructors are required to install pressure differential monitoring devices to measure and monitor ongoing pressures on the work area.

F.2.5 Distribution of CAHUs

On large construction spaces, distributing the CAHUs throughout the workspace may provide for better pressure distribution. However, this is not always practical and CAHUs may need to be clustered near an area of exhaust (e.g., a window) in order to facilitate the remainder of the construction. By clustering units, the distribution of pressure within the construction zone becomes irregular (i.e., strong pressure near the clustered CAHUs with notably reduced pressure at distances from the CAHUs). Recognizing that Clause 6.6.1.3 identifies the minimum pressure requirement, more CAHUs can be necessary to increase the minimum pressure to the specified level.

F.2.6 Condition of filter and filter media

As pre-filters, secondary filters, and HEPA filters are used in demolition areas, they begin to load up with particulate debris. While pre-filters and secondary filters may become more efficient at stopping particulate when initially put into use, as they continue to load, their efficiency diminishes as the openings through the filters become blocked. Eventually, these filter media approach complete blockage and static pressure increases significantly. The CAHUs lose their ability to move air as the filters are blocking the air travel path. As a result, CAHUs can function well below their rated airflow capacities during these times. In addition, the physical arrangement of the filters within the CAHU might impact the fan's ability to move the rated air capacity.

F.3 Example

Inside an existing HCF, a renovation project is planned to completely demolish and rebuild an existing nursing unit. All patient rooms and service areas, including all partitions and supporting mechanical and electrical systems, are to be removed. The space is being rebuilt to provide ambulatory care services. The space is approximately 40 m wide x 60 m long. The ceiling height is 3 m, with an additional 0.8 m above the T-bar ceiling to the underside of the drywall ceiling.

The following calculation estimates the number of CAHUs needed to draw this space under the pressure required by Clause 6.6.1.

Space area = 40 m wide x 60 m long = 2400 m^2

Space volume = 2400 m^2 x 3.8 m high = 9120 m^3

Pressurization required assuming 4 ACH = 9120 m^3 x 4 ACH = 36 480 m^3/h or 36 480 000 L/h.

Employing a 3600 s/h conversion, this equates to
36 480 000 L/h/3600 = 10 133 L/s
CAHU relative efficiency* = 10 133 L/s/75% = 13 510 L/s

OPTION 1:
If the constructor has a supply of 2000 CFM CAHUs available (see Clause F.4):
Number of CAHUs required = 13 510 L/s (required) / 944 L/s (CAHU capacity) = 14.31 or 15

The constructor might consider using fifteen 2000 CFM CAHUs in this renovation space.

OPTION 2:
If the constructor has a supply of 3500 CFM CAHUs available (see Clause F.4):
Number of CAHUs required = 13 510 L/s (required)/1652 L/s (CAHU capacity) = 8.18 or 9
The constructor might consider using nine 3500 CFM CAHUs in this renovation space.

In all cases, after the CAHUs have been estimated, positioned in the construction zone, and turned on, pressure differential monitoring devices are used to ensure that the required level of pressure is being attained across all critical interfaces between the construction zone and hospital zones.

* *CAHU efficiency can depend on a number of factors. Depending on the following variables, additional CAHUs could be needed:*
a) cleanliness of internal filter;
b) cleanliness of pre-filter and frequency of changes;
c) type of construction or demolition;
d) amount of dust in construction zone;
e) lengths of HEPA unit exhaust ducts, and whether they are partially kinked;
f) air leakage into the room from perimeter;
g) position of HEPA units in space and position of internal walls;
h) actual motor fan speed inside HEPA unit; and
i) time since last HEPA unit verification.

F.4 Common availability of CAHUs

There are several manufacturers of CAHUs, and sizes and combinations of units are seemingly endless. Generally speaking, CAHUs are still sold based on their air flow capacities measured in CFM (cubic feet per minute). Table F.1 offers some typical sizing of units. Constructors should consult with local suppliers to determine the types of units that may be available in their area.

Table F.1
Typical sizing of units
(See Clause F.4)

Type of CAHU	Common rating, CFM	Metric rating, L/s
Vacuum cleaners	75	35
	100	47
	150	70
	200	95
	250	118
Variable speed	0–600	0–283
	0–800	0–378
	0–1000	0–472
Dual speed	1200	566
	1400	660
	1600	755
	1800	849
	2000	944
	2400	1133
	2800	1321
	3000	1416
	3500	1652
	4000	1888
	5000	2360

Notes:

1) *Constructors are encouraged to consult with their local suppliers to determine the exact CAHUs that might be available before selecting CAHUs to be used on any given construction/renovation project.*

2) *If a booster fan is used downstream of a CAHU, the fan rating should be compatible with the output of the CAHU.*

Annex G (informative)
Additional sample checklists

Notes:

1) *This informative Annex has been written in mandatory language to facilitate its use in HCF procedures.*

2) *The checklists in this Annex may be used in the implementation of preventive measures for the project. These should not be taken as comprehensive, as project-specific considerations could necessitate the addition or revision of specific items.*

3) *See Annex C for a sample preventive measures analysis form.*

Checklist G.1
Preventive measures checklist — Example

Element		Compliance			Notes
		Yes	No	N/A	
1.0	**Level I measures**				
1.1	High risk patients have been identified, who need to be temporarily moved away from work area or otherwise protected				
1.2	Patient care equipment and supplies have been removed or protected				
1.3	Work has been scheduled during periods of low user activity				
1.4	New materials are being kept clean and dry				
1.5	Methods are being used that minimize the generation and dispersion of dust (i.e., HEPA vacuums or drills)				
1.6	Water and/or ventilation systems have been identified that could be impacted				
1.7	Work areas are HEPA vacuumed and/or wet mopped as necessary throughout project and upon completion				
1.8	Plumbing is in accordance with CSA Z317.1				
2.0	**Level II measures — All Level I measures shall be implemented in addition to the following:**				
2.1	Methods are being used that minimize dispersion of dust (i.e., HEPA vacuums or air handling units, poly barriers, drop sheets)				
2.2	Doors and openings are sealed with tape or poly				
2.3	HVAC system supply and return/exhaust air ducts are sealed or isolated				
2.4	Walk-off/tack mats are at entrance/exit to site and are being changed as needed				

(Continued)

Checklist G.1 (Continued)

Element		Compliance			Notes
		Yes	**No**	**N/A**	
2.5	Safe route is in place for transportation of clean/ sterile supplies				
2.6	Traffic pattern has been established for construction workers that reduces and if possible avoids adverse impacts on care areas				
2.7	Proper debris removal procedures are in place (i. e., after hours removal, covered carts, carts wiped down before leaving site)				
2.8	Water lines in construction area are flushed for 10 min before patient occupancy				
2.9	Terminal clean is performed by housekeeping prior to patient occupancy				
3.0	**Level III and IV measures — All Level I and II measures shall be implemented in addition to the following:**				
Before project begins					
3.1	Multidisciplinary team (MDT) meetings have been set up				
3.2	Essential services that could be disrupted have been identified				
3.3	Staff in the work area are aware of infection risks and are educated in risk mitigation measures as appropriate to their work activities				
3.4	ICRA form completed and signed by PM and ICP				
3.5	Process in place to ensure that any changes to project scope are reviewed with ICP/MDT				
3.6	Measures in place regarding plumbing system work and potential water disruptions: • Temperature limits established (CSA Z317.1) • Disruptions, if needed, have been scheduled during times of low user activity • Alternative potable water source available, if needed • Disinfection procedure completed on water systems affected by major plumbing activities (i.e., flushing, superheating, hyperchlorination)				
3.7	Impermeable dust barrier erected from floor to the true ceiling, consisting of two layers of 6 mil poly and gypsum wallboard protective layer* ** According to Clause 6.6.1.2, the composition of the barrier may be modified where deemed appropriate by the MDT to suit time, space, or impact constraints. Alternative forms of*				

(Continued)

Checklist G.1 (Continued)

Element		Compliance			Notes
		Yes	No	N/A	
	construction or containment products may be used if they can be shown to provide an equivalent barrier.				
3.8	Anteroom (when required)* • Large enough to enable materials to be moved through without having to open both doors at the same time • Barrier extends above false ceiling (either entrance or exit wall of the anteroom should be extended to the underside of the deck and any openings sealed) • Entry doors have gasketed frames and closers • Negative pressure: at least 2.5 Pa in anteroom relative to hospital zone • Walk-off tack mats at entry to anteroom door and inside anteroom * *Anterooms are required for Level IV work. For Level III/IV projects, the use of an anteroom is at the discretion of the MDT.*				
3.9	All seams/penetrations to work area are sealed (doors, plumbing, intake/exhaust vents, electrical outlets, screw heads, etc.), including those above false ceilings				
3.10	Appropriate pressure differential established between work area and occupied areas: • Minimum 7.5 Pa differential maintained • Pressure differential monitoring device in place and data logged • Device alarmed when deemed necessary by MDT				
3.11	Construction air handling unit(s) (CAHUs): • Number of units needed to maintain necessary pressure differential for size of space has been calculated • HEPA filtration - DOP tested on site prior to start of project or within last 12 months (min.), with documentation • Filters changed as needed • Air is exhausted to the outside unless permitted by the multi-disciplinary team				
3.12	Dedicated service elevator (if available) has been designated for use				
3.13	Owner representatives, health care facility project managers, and key MDT members have taken the				

(Continued)

Checklist G.1 (Continued)

Element		Compliance			Notes
		Yes	No	N/A	
	training provided by CSA Group, or equivalent, in the use and application of this Standard. **Note:** *The CSA training includes one day on the fundamental principles, and one day on implementation and practical application of this Standard.*				
3.14	Constructor's primary construction managers, project managers, and site superintendents have taken the training provided by CSA Group, or equivalent, in the use and application of this Standard.				
3.15	Key subcontractors (HVAC, plumbing etc.) have taken the training provided by CSA Group, or equivalent, in the use and application of this Standard.				
3.16	Prime consultant and other key consultants (i.e., infection prevention and control) have taken the training provided by CSA Group, or equivalent, in the use and application of this Standard.				
During project					
3.17	Dust barrier integrity is inspected frequently and breaches are immediately repaired				
3.18	Dust suppression is being done within work area (water misting work surfaces, HEPA-filtered vacuums, walk-off sticky mats, etc.)				
3.19	HEPA vacuuming performed on mechanical and electrical equipment and interior cavities before installation of hard or T-bar ceiling, and the closing of walls				
3.20	Procedures and necessary equipment and PPE in place for construction workers to HEPA vacuum clothes or wear a containment suit prior to leaving construction area and entering patient care areas				
3.21	HVAC ductwork protected from dust and moisture (Standard specifies that ductwork must be stored in a clean area and ends sealed until installation)				
3.22	Dead leg water pipes in the plumbing system removed at the connection to the main line				
3.23	Building windows and doors kept closed and intake filters changed more frequently when excavation is taking place				

(Continued)

Checklist G.1 (Concluded)

Element		Compliance			Notes
		Yes	**No**	**N/A**	
	Soil watered down as needed to minimize dust migration				
3.24	Determination of whether air sampling is needed has been made in consultation with the MDT prior to the start of work. If sampling to be done, provision has been made for • baseline sampling, • periodic or ongoing sampling during the work, and • procedures to follow if sampling results indicate that a problem exists				
3.25	Members of the MDT conduct routine site visits throughout the project				
End of project					
3.26	If water lines are shut down or accessed during construction, they are flushed before reusing (minimum of 10 min). Consideration should be given to disinfecting water systems affected by major plumbing activities (superheating, hyperchlorination, etc.)				
3.27	Work area is thoroughly cleaned and barriers are cleaned before dismantling				
3.28	Air filters changed/cleaned as necessary in work areas and ventilation systems are functioning properly and are cleaned if contaminated during work activities				
3.29	Dust barriers/anterooms removed carefully to minimize dust migration				
3.30	Final visual inspection of the of the work area and terminal clean conditions achieved before patients are readmitted to the area				
3.31	Review is conducted after completion to assess the effectiveness of preventive measures and identify possible improvements				

Checklist G.2
Construction clean checklist (below ceiling plane)

Area:			**Room number:**	
Description	**Cleaning**	**Date**	**Time**	**Cleaner**
Horizontal surfaces				
Counters	HEPA vacuum			
Shelves	HEPA vacuum			
Doors/frames	HEPA vacuum			
Reveals	HEPA vacuum			
Headwalls	HEPA vacuum			
Nook	Damp cloth			
Diffusers	Damp cloth			
Light lenses	Damp cloth			
Millwork				
Drawers	HEPA vacuum			
Desk Top	Damp cloth			
Cupboards	HEPA vacuum			
Flooring				
Sheet vinyl	Damp mop			
Tile	Damp mop			
Concrete	HEPA vacuum			
Mechanical/ electrical rooms				
Floors	HEPA vacuum			
Walls	Dry cloth			
Equipment	Dry cloth			
Cabinets	HEPA vacuum			
Washrooms				
Sink/Counter	Damp cloth			
Toilet	Damp cloth			
Shower walls	Damp cloth			

(Continued)

Checklist G.2 (Concluded)

Floors	Damp mop			
Mirrors	Damp cloth			
Windows and sills	Damp cloth			
When the room cleaning is complete, post this checklist on the entrance door				

Checklist G.3
Construction clean checklist (above-ceiling plane infrastructure)

Room # _____ Room Name: _____

The cleaning process shall be sequenced from higher to lower elevations so that dust is not aerosolized or brushed onto already clean surfaces. Cleaning staff working above the ceiling plane shall do so in accordance with applicable requirements. Cleaning cloths shall be rinsed in clean water when soiled. Caution should be used around sprayed insulation. This material should not be vacuumed or cleaned.

Note: *Provincial/territorial safety regulations can apply.*

Infrastructure	Cleaning process	Comments	Initial
Underside of ceiling	HEPA vacuum		
Steel beams	HEPA vacuum		
Steel joists	HEPA vacuum		
Ductwork (all 4 sides)	Damp cloth		
Ductwork insulated (all 4 sides)	Damp cloth		
Electrical conduit	Dry cloth		
Electrical shielded cable	Dry cloth		
Electrical junction boxes	Dry cloth		
Plumbing drain piping	Damp cloth		
Plumbing supply piping	Damp cloth		
Plumbing insulated piping	Damp cloth		
Cable tray wiring	Dry cloth		
Ceiling supported hangers	Damp cloth		
Ceiling supported support channels	Damp cloth		
Top surfaces of gypsum ceiling	HEPA vacuum		
Top surfaces of ceiling hatch	Damp cloth		
Top of low wall horizontal surface	Damp cloth		
Interior of low wall without cap	HEPA vacuum and long hose		
Top of exposed light fixture	Dry cloth		
Top of HVAC diffusers	Damp cloth		
Medical gas lines	Damp cloth		
Top of smoke or fire detectors	Damp cloth		

(Continued)

Checklist G.3 (Concluded)

Infrastructure	Cleaning process	Comments	Initial
Supports for ceiling mounted equipment	Damp cloth		

Completed by: Date:

When the room cleaning is complete, post this checklist on the entrance door

Checklist G.4
Final construction clean checklist (below ceiling plane)

Segment:			**Room number:**	
Description	**Cleaning**	**Date**	**Time**	**Cleaner**
General				
Doors/frames	Damp cloth			
Reveals	Damp cloth			
Headwalls	Damp cloth			
Nook	Damp cloth			
Diffusers	Damp cloth			
Light lenses	Damp cloth			
Millwork				
Drawers	Damp cloth			
Desk Top	Damp cloth			
Cupboards	Damp cloth			
Counters	Damp cloth			
Shelves	Damp cloth			
Flooring				
Sheet vinyl	HEPA vacuum			
Tile	HEPA vacuum			
Concrete	HEPA vacuum			
Mechanical/ electrical rooms				
Floors	HEPA vacuum			
Walls	Damp cloth			
Equipment	Damp cloth			
Cabinets	Damp cloth			
Washrooms				
Sink/Counter	Damp cloth and disinfectant			

(Continued)

Checklist G.4 (Concluded)

Toilet	Damp cloth and disinfectant			
Shower walls or tubs	Damp cloth and disinfectant			
Floors	Damp cloth and disinfectant			
Mirrors	Damp cloth and disinfectant			
Windows and sills interior only	Damp cloth			

When the room cleaning is complete, post this checklist on the entrance door

Checklist G.5
Construction air handling unit inspection sheet

	Date: Month Day	Date: Month Day	Date: Month Day	Date: Month Day
Pre filter checked				
Pleated filter checked				
HEPA filter inspected				
Pre filter changed				
Pleated filter changed				

	Date: Month Day	Date: Month Day	Date: Month Day	Date: Month Day
Pre filter checked				
Pleated filter checked				
HEPA filter inspected				
Pre filter changed				
Pleated filter changed				

	Date: Month Day	Date: Month Day	Date: Month Day	Date: Month Day
Pre filter checked				
Pleated filter checked				
HEPA filter inspected				
Pre filter changed				
Pleated filter changed				

	Date: Month Day	Date: Month Day	Date: Month Day	Date: Month Day
Pre filter checked				
Pleated filter checked				
HEPA filter inspected				
Pre filter changed				
Pleated filter changed				

Please initial every day

Annex H (informative)
Sample template for project analysis and infection control risk assessment

Note: *This informative Annex has been written in mandatory language to facilitate its use in health care facility procedures.*

Matrix of precautions for construction and renovation

H.1 General	
Location of construction:	**Project No.:**
Project coordinator:	**Project start date:**
Contractor performing work:	**Estimated duration:**
Supervisor:	**Telephone:**
Description of work:	

Background:
Construction can be a cause of hospital outbreaks that lead to significant infections and even deaths. Workers need to be aware of the risks and the necessary precautions when they are working in a health care facility that has a large proportion of seriously ill and immunocompromised patients. Even non-patient care areas within the hospital can impact on patients, e.g., contaminated air ducts, bandages, pharmacy supplies. Therefore, it is most important that the guidelines below are followed during construction. Please note that occasionally during construction, modifications are made to the original specifications. If these will change the level of construction activity, this assessment could need to be updated.

H.2 Population risk groups (as marked)			
Group 1 Lowest	☐	• office areas • unoccupied wards • public areas	• laundry and soiled linen cleaning areas • physical plant workshops and housekeeping areas
Group 2 Medium	☐	• patient care areas, unless listed in group 3 or group 4 • outpatient clinics (except oncology and surgery) • admission and discharge units • waiting rooms	• autopsy and morgue • occupational therapy and physical therapy areas remote from patient care areas
Group 3 Medium high	☐	• emergency room (except trauma) • imaging • labour and delivery (non-operating) • nurseries for healthy newborns • nuclear medicine • hydrotherapy • echocardiography • laboratories	• general medical and surgical wards • pediatrics • geriatrics • long-term care • food preparation, serving and dining areas • respiratory therapy • clean linen handling and storage areas
Group 4 Highest	☐	• intensive care units • operating rooms (including pre, induction PACU, and scrub areas) • anaesthesia storage areas and workrooms • oncology units and outpatient clinics • transplant units and outpatient clinics • wards and outpatient clinics for patients with AIDS or other immunodeficiency diseases • dialysis units • critical care nurseries • labour and delivery operating rooms • cardiac catheterization and angiography • cardiovascular and cardiology patient areas	• endoscopy • pharmacy admixture rooms • sterile processing department, rooms and supply rooms • burn care units • animal rooms • trauma rooms • protective environment isolation rooms • tissue culture laboratories • bronchoscopy • cystoscopy • pacemaker insertion rooms • dental procedure rooms

H.3 Construction activity type(as marked)	
Type A	Inspection and non-invasive activities. Includes, but is not limited to, • activities that involve a single controlled opening in a wall or ceiling for minor work or visual inspection, that is accessed by – removing no more than one ceiling tile; or – opening of an access panel on a wall or ceiling • painting (but not sanding) and wall covering • electrical trim work • minor plumbing work that disrupts the water supply to the localized patient care area (i.e., one room) for less than 15 min • other maintenance activities that do not generate dust or require cutting of walls or access to ceilings other than for minor work or visual inspection as described in the first bullet above
Type B	Small-scale, short-duration (e.g., less than 2 h) activities that create minimal dust. Includes, but is not limited to • activities that require access to and use of chase spaces • cutting a small opening in a contained space where dust migration can be controlled, e. g., cutting of walls or ceilings to provide an access point for installing or repairing minor electrical work, ventilation components, telephone wires, or computer cables • sanding or repair of a small area of a wall • plumbing work that disrupts the water supply of one or more patient care areas for less than 30 min
Type C	Activities that generate a moderate to high level of dust, cause a moderate service disruption, require demolition, require removal of a fixed facility component (e.g., a sink) or assembly (e.g., a countertop or cupboard) or cannot be completed in a single work shift. Includes, but is not limited to, • activities that require sanding of a wall in preparation for painting or wall covering • removal of floor coverings, ceiling tiles and casework • new wall construction • minor ductwork • electrical work above ceilings • major cabling activities • plumbing work that disrupts the water supply of one or more patient care areas for more than 30 min, but less than 1 h
Type D	Activities that generate high levels of dust, activities that necessitate significant service disruptions, and major demolition and construction activities requiring consecutive work shifts to complete. Includes but is not limited to, • soil excavation • new construction that requires consecutive work shifts to complete • activities that involve heavy demolition or removal of a complete cabling system • plumbing work that disrupts the water supply of one or more patient care areas for 1 h or more

H.4 Infection control measures: (Contractor to initial and date any PM III, IV, and additional requirements)

PM I	1. Review infection control construction agreement before work begins. 2. Execute work by methods to minimize raising dust from construction operations. 3. Protect patient care equipment and supplies from dust exposure. 4. Immediately replace any ceiling tile displaced for visual inspection. 5. Report discoloured water and water leaks to maintenance. **Comments/Special Instructions:**
PM II	**PM I measures shall be followed** 1. Determine a safe route for the transportation of clean or sterile supplies and equipment away from the construction area. 2. Establish traffic patterns for construction workers that avoid, or at the minimum reduce, adverse impacts on patient care areas. 3. Provide active means to prevent airborne dust from dispensing into atmosphere. 4. Water mist work surfaces to control dust while cutting. 5. Seal unused doors with duct tape. 6. Block off and seal air vents. 7. Wipe work surfaces with disinfectant. 8. Contain construction waste before transport in tightly covered containers. 9. Vacuum the area (with HEPA-filtered vacuum) and wet mop area daily with a hospital-grade low-level disinfectant. 10. Place dust mat at entrance and exit of work area. 11. Remove or isolate HVAC system in areas where work is being performed. 12. Flush potable water lines in the construction area and adjacent areas before reuse. **Comments/Special Instructions:**
PM III Date:	**PM I and II measures will be followed** 1. Obtain infection control permit before construction begins. 2. Isolate HVAC system in area where work is being done to prevent contamination of duct system. 3. Complete all critical barriers or implement control cube method from floor to true ceiling (includes the areas above false ceilings) before construction begins. 4. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 5. Do not remove barriers from work area until complete project is thoroughly cleaned by housekeeping.

Initials:	6. Vacuum the area (with a HEPA-filtered vacuum) and wet mop area daily with a hospital-grade low-level disinfectant. 7. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. 8. Contain construction waste before transport in tightly covered containers. 9. Cover transport receptacles or carts. Tape covering. 10. Remove or isolate HVAC system in areas where work is being performed. 11. Consider hyper-chlorinating or superheating stagnant potable water. **Comments/Special Instructions:**
PM IV Date: Initials:	**PM I, II, and III measures shall be followed** 1. Construct anteroom at access points to the construction area if access is from within the health care facility. 2. Place walk off mat outside the anteroom in patient care areas and inside the anteroom. 3. Ensure construction workers a) leave the construction area through the anterooms so they can be vacuumed using a HEPA vacuum cleaner before leaving work site; or b) wear protective clothing that is to be removed each time they leave the construction area and before going into patient care areas. 4. Repair holes in walls within 8 h or seal them temporarily. 5. Ensure that ventilation systems are working properly in adjacent areas. **Comments/Special Instructions:**

H.5 Infection control risk assessment:

Step 1. Identify the areas surrounding the project area, assessing potential impact:

Unit below	Unit above	Lateral left	Lateral right	Behind	Front
Risk group	Risk group	Risk group	Risk group	Risk group	Risk group

Step 2. Identify the specific site of activity, e.g., patient room, medication room, etc.:

_____

_____

Step 3. Identify issues related to ventilation, plumbing, and electrical in terms of occurrence of probable outages and coordinate arrangements with clinical department manager, operation and maintenance managers, and infection prevention and control. Work hours must be determined in consultation with clinical area manager, plant maintenance, and infection prevention and control:

_____

_____

Step 4. Identify containment measures, using prior assessment. Identify types of barriers (e.g., solid walls, 6 mil poly):

_____

_____

_____

Step 5. Consider potential risk of water damage. Is there a risk due to compromising structural integrity? (e.g., wall, ceiling, roof):

_____

Step 6. Plan to discuss the following containment issues with the project team:

a) Traffic flow:

_____

b) Housekeeping:

_____

c) Debris removal (how and when?)

_____

Identify and communicate the responsibility for project monitoring that includes infection prevention and control concerns and risks. The ICRA may be modified throughout the project but must be approved by infection prevention and control and the project manager.

H.6 Additional requirements:	
Permit requested by:	Permit authorized by:
Contractor signature:	Infection control signature:
Date:	Date:

References:

Health Canada. 2001. *Construction-Related Nosocomial Infection in Patients in Health Care Facilities: Decreasing the Risk of* Aspergillus, Legionella*, and Other Infections*. Ottawa, ON. [Electronic version] http://publications.gc.ca/collections/collection_2016/aspc-phac/HP3-1-27-S2-eng.pdf

CSA Group. Z317.13-17. *Infection control during construction, renovation, and maintenance of health care facilities*.

Annex I (informative)
HVAC ductwork installation method statement

Note: *This Annex is not a mandatory part of this Standard.*

Introduction

This HVAC method statement has been developed to provide a comprehensive record of the procedures and steps involved in the supply, transportation, assembly, and installation of the new HVAC duct system for a health care facility. This method statement supplements the SMACNA, Advanced Level for duct supply and installation, and CSA Z317.13. In the majority of cases, the supply of duct work is done in an assembled manner. However, in some cases due to geographic, logistic and cost parameters, some ducts are supplied as basic components with the final assembly being done on the construction site.

The goal is to ensure that all steps are carried out in the most practical and economical manner with the end users' health and safety in mind.

Fabrication

a) Shop personnel fabricating and handling ductwork for this project are instructed with a tutorial on the clean duct requirements outlined under SMACNA, CSA Z317.2, and CSA Z317.13. Refer to attached sign off sheet _____.
   Note: *A sign-off sheet can be used to keep track of who has had the tutorial.*
b) Shop facilities are maintained at a cleanliness level compatible with SMACNA and CSA Group standards. Refer to attached checklist _____.
   Note: *A checklist can be developed for this Item.*
c) Material suppliers are notified of the standard for delivery of all duct work being shipped to the health care facility project.
d) Component suppliers are notified of the standard for delivery of equipment being shipped to the health care facility project.
e) All materials are received, inspected, and determined suitable to be used in the manufacturing process. Refer to attached checklist _____.
   Note: *A checklist can be developed for this Item.*

Packaging and transportation to the construction site

a) All ductwork and components are inspected for cleanliness prior to packaging for shipment to site. Refer to attached checklist _____.
   Note: *A checklist can be developed for this item.*
b) The transportation company is advised of the handling requirements for the containers as outlined under SMACNA and CSA Group standards.

On-site handling and storage

a) All on site personnel are instructed with a tutorial on the clean duct requirements outlined under SMACNA and CSA Group standards. Refer to attached sign off sheet _____.
   Note: *A sign-off sheet can be used to keep track of who has had the tutorial*
b) Containers are received on-site and inspected for damage.
c) Containers are brought into the building, opened, sorted, and inspected. Refer to attached checklist _____.
   Note: *A checklist can be developed for this item.*

d) Any components that do not meet the cleanliness standard are cleaned with a clean cloth and re-inspected.
e) Duct sections, if assembled, on site are capped/sealed with plastic at both ends.
f) Any components that need to be cut/adjusted on site are taken to the cutting room, then cleaned and inspected to meet the standard before being stored in a clean area then covered with a clean sheet of poly.
g) Clean, sorted material are wrapped and stored in a designated clean area for future assembly and installation.

On-site assembly and installation

a) A clean area for assembly and installation is prepared.
b) Clean, wrapped material (ductwork, fittings, and components) are brought into the clean area and assembled.
c) Once assembled, all pieces are inspected. Refer to attached checklist _____.
Note: *A checklist can be developed for this Item.*
d) If there is a need to be cleaned further (either on the inside/outside) it would be done so with a clean cloth and re-inspected before being hung and capped.
e) Clean duct components are hung and openings are retained as capped/sealed with plastic.
f) All air handling unit (AHU) access doors/side panels will be installed and remain closed throughout construction to eliminate dust infiltration. In the event that an AHU access door/side panel is required to be opened, a portable ante-room will be set up at the door while working.
g) When construction reaches the finishing stage, all caps are removed as needed and the terminations (including grilles and diffusers) are installed and then re-capped/sealed with plastic.
h) Caps are not removed until the entire system is ready for start-up. Refer to attached checklist _____ which indicates that the system is ready for start-up.
Note: *A checklist can be developed for this Item.*

Additional recommendations

a) Throughout the process an infection control inspector or audit person should review and monitor the processes throughout this methods statement.
b) This inspection should include retention of some of the various checklists utilized as well as a photographic record of the inspections or audits.
c) Verifications of the inspections or audits should be made available in writing to the mechanical contractor responsible for the duct installation, the general contractor, and the health care facility.
d) Variances to the inspections or audits should also be made available to the project multi-disciplinary team.

Annex J (informative)
Bibliography

Note: *This Annex is not a mandatory part of this Standard.*

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