B.C. Buildings Corporation

Mandatory Preventive Maintenance Standard

To Meet Section 4.78 of the WCB OH & S Regulation

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BCBC WCB-IAQ Steering Committee

BC Buildings Corporation

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INTRODUCTION

This mandatory preventive maintenance Standard shall be implemented across the Corporation to meet the requirements in Section 4.78 of the WCB Occupational Health and Safety (OH & S) Regulation. Section 4.78 is a part of the indoor air quality (IAQ) requirements contained in Sections 4.70 through 4.80 of the WCB Regulation. For acceptable IAQ to be maintained, not only must the design of ventilation systems be such as to ensure adequate provision, conditioning and distribution of ventilation air to occupied spaces, but the systems installed must be maintained to ensure continued effective operation. Accordingly, in Section 4.78, the WCB Regulation requires "an effective preventive maintenance program" for ventilation systems, and provides a set of minimum requirements. Of course, any effective preventive maintenance program will not only meet all applicable regulations, it will also be an integral part of good facility management practice.

The purpose of this document is to provide guidance to BCBC Property Management staff as to the preventive maintenance (PM) tasks required in order to meet Section 4.78 of the WCB Regulation. The main body provides this information, but it is important to point out two things:

- the WCB does NOT require PM for all equipment in HVAC systems, and
- other Regulations (e.g. boiler and gas safety, ozone depleting substances, backflow prevention) may contain PM and testing requirements - these are NOT reflected in the body of this document.

This document does contain Appendices which include some recommended PM tasks for various equipment, and suggestions for additional equipment which should be considered for a PM program. The material contained in the Appendices is NOT required by the WCB Regulation. But some of it might be required under other Regulations.

The exact form of the PM documentation will undoubtedly vary from District to District. Some will use computer-based spreadsheets. Others may choose to use a purchased Preventive Maintenance Management computer software package. Still others may stick with paper-based record keeping. Regardless of the means of keeping the documentation, its content must be consistent with the requirements of this Standard, and must specifically identify who has done the work. If the work was completed by a contractor, both the company name and the name of the service mechanic or technician must be included.. In addition, the front-line preventive maintenance work actually carried out in the field must also be consistent across the Corporation.

In general, the preventive maintenance information in this Standard is presented by system, and includes 3 parts:

- a definition of what is typically included in each type of system,
- inventory information, which needs to be recorded once, and only updated if changes to equipment are made, and
- preventive maintenance tasks (includes required inspections) and frequency.

DISCLAIMER

These Preventive Maintenance Requirements are intended for the use of the British Columbia Buildings Corporation and its Clients (Ministries and Agencies of government).

Copies of these requirements may be provided, upon request, to Landlords from whom the Corporation is leasing space. However, this document is **NOT** intended to direct any Landlord as to their compliance with any aspect of the WCB OH & S Regulation.

BCBC RESPONSIBILITIES

In corporate-owned buildings, BCBC is responsible for planning, carrying out and documenting a PM program which meets the WCB Regulation. The main body of this document provides information concerning these requirements. According to Corporation policy, such a PM program is mandatory in corporate-owned buildings.

In maintained-only buildings, the Corporation is only responsible for carrying out those tasks which are included in the scope of work contained in the Agreement. If the scope of work does not cover the minimum requirements of the IAQ sections of the WCB Regulation, that is the building owner's responsibility, not the Corporation's. However, the Corporation may wish to propose a revision to the scope of work to include this work - with an appropriate fee adjustment.

In buildings leased from a Landlord, the Landlord will be responsible for all maintenance work in the building unless the Lease Agreement specifically assigns some maintenance work to the Corporation. If the Corporation has **ANY** maintenance responsibilities under the Lease Agreement, Property Management must be certain whether or not any responsibility for meeting the WCB PM requirements has been delegated to the Corporation. If there is **ANY** doubt about this, then it is recommended that Leasing be consulted, and a clear understanding determined on this point.

REQUIREMENTS of SECTION 4.78, WCB OHS REGULATION

Section 4.78 of the WCB OHS Regulation contains the requirements for preventive maintenance programs in buildings. The full text of Section 4.78 is reprinted below.

4.78 (1) To maintain acceptable air quality, the employer, or if the employer is not responsible for maintenance of the ventilation system, the owner of the ventilation system or the owner's agent, must establish an effective preventive maintenance program for the ventilation system.

(2) Preventive maintenance must include

(a) regular inspections

(i) of all critical components of the ventilation system, such as dampers, fans, belts, baffles, ductwork, diffusers and control systems, and

(ii) for conditions which would promote the growth of micro-organisms, such as water leaks or stagnant water pools,

(b) correction of any deficiencies found during the inspections carried out under paragraph (a),

(c) repair or replacement of malfunctioning and consumable components, such as filters and belts, and the cleaning of air distribution systems, ducts and dampers when necessary to correct an indoor air quality deficiency,

(d) adequate treatment of open water systems associated with ventilation equipment such as cooling towers and humidifiers, to control biological growth, and

(e) maintenance of combustion sources, such as furnaces, space heaters and water heaters to assure proper burning and exhausting of waste gases so that recirculation of gases to the workplace will not occur.

These requirements apply to virtually all **"indoor or enclosed areas when occupied by workers".** The following items in this section highlight the requirements in Section 4.78, and give very brief commentary concerning what constitutes an acceptable preventive maintenance program. The words contained within quotation marks are taken directly from Section 4.78 of the WCB Regulation.

1. There must be **"regular inspections of all critical components"** of ventilation systems. The acceptable frequency of inspections will be determined by:
   - the required service or maintenance frequency, and
   - the negative impact if a failure occurs.

2. There must be **"regular inspections for conditions which would promote the growth of micro-organisms".** Growth of micro-organisms is almost universally associated with moisture. Examples of such conditions are:
   - leaks which lead to building materials being damp for an extended period of time,

- poor foundation drainage, leading to water collecting in crawlspaces or other areas from which micro-organisms could migrate into occupied spaces,
- stagnant water pools, particularly inside the building (e. g. in ductwork, under cooling coils, in condensate drain pans, or in plenums), or
- stagnant water pools (on the ground, on roofs, or in untreated cooling tower or similar sumps) located near ventilation air intakes so micro-organisms could be pulled into the building's ventilation system.

3. The **"correction of any deficiencies found during the inspections"** carried out under items 1 and 2. The nature of the "correction" required will vary, depending on the type of "deficiency" discovered during the inspection.

4. The **"repair or replacement of malfunctioning and consumable components".** Components which cannot be repaired, such as air filters (which load up with filtered particulates) or drive belts (which gradually wear out), should be replaced before they fail or their performance deteriorates to unacceptable levels. This can be done either on a scheduled basis or if the regular inspection indicates they are reaching the end of their reliable service lives.

   Components which can be serviced, repaired or re-calibrated in order to return them to effective operation, may be maintained as required rather than being replaced.

5. The **"cleaning of air distribution systems, ducts and dampers when necessary to correct an indoor air quality deficiency."** When air filtration is inadequate, dirt and other airborne contaminants will enter and may collect in the air distribution system. With sufficient build-up, contaminants can be transported into the occupied space, causing an indoor air quality problem. Proper air filter replacement will eliminate this problem, or greatly reduce its likelihood.

   When moisture either enters a duct system or is routinely present in it (for example a cooling coil condensate drain pan with poor drainage), the potential negative impact of dirty air distribution systems is aggravated. Moist dirt in warm ducts provides an ideal growth environment for micro-organisms. Contaminants, including micro-organisms, can be transported into the occupied space, causing an indoor air quality problem which is not merely irritating, but which could be a risk to occupant health.

   In either of the situations just described, the air distribution systems are required to be cleaned. It is important to note that routine, scheduled duct cleaning is <u>not</u> required. However, regular inspections to ascertain the cleanliness of duct systems is a requirement.

   In the event of a dirt or contamination problem in ducts, an effective preventive maintenance program will, in addition, ensure the causes of the contaminant and/or moisture build-up are identified and corrected in order to prevent a repetition of the problem in future.

6. The **"adequate treatment of open water systems associated with ventilation equipment . . . to control biological growth."** There are two types of "open water systems" in buildings.

   First, there are cooling towers and evaporative cooling units, associated with mechanical cooling systems. These require an effective water treatment program, regular inspection, and cleaning and disinfecting if the inspection indicates a need to do so.

   Second, there are humidifiers. These typically use domestic water, which in many parts of B. C. is very hard, leading to a build-up of "crud" in the humidifier. The use of softened water in humidifiers should be considered. In addition, humidifiers should be operated such that they are drained when not in active use, and they should be mechanically cleaned on a regular basis.

7. The **"maintenance of combustion sources".** This means regular calibration and servicing of all fossil fuel burners to ensure correct operation, with all safety components tested and fully operational. It also covers correct venting or **"exhausting of waste gases"** in order to prevent them entering the occupied space by any route.

DOCUMENTATION REQUIREMENTS OF THE WCB REGULATION

Documentation of preventive maintenance schedules is mandatory for two reasons. First, Section 4.78 of the WCB Regulation requires documentation to demonstrate the existence of an acceptable program. This documentation must be kept for at least seven (7) years, and it must be accessible so it can be provided to a WCB Officer upon request. The documentation does not need to be kept in the building to which it pertains. It can be kept it a central office provided it is indexed to the specific building for easy access. Second, to provide guidance to both in-house maintenance staff and to maintenance contractors on what tasks are required, and at what frequency.

In addition to Section 4.78, there are documentation requirements in Section 4.9 of the WCB Regulation which relate to preventive maintenance. Section 4.9 requires that the **"make, model and serial number"** of all equipment required **"to have an inspection and maintenance record"** must be documented. Also, for all such equipment **"detailed reports of inspection, maintenance, repairs and modifications must be kept".** These "detailed reports" must include:

- date(s) when inspection or maintenance work is carried out,
- who carried it out,
- a list of components and conditions inspected
- the conditions found,
- related preventive maintenance schedules and lists of work to be done, and
- a description of all service/repair/replacement work undertaken.

GENERIC PREVENTIVE MAINTENANCE INFORMATION

On the pages which follow, preventive maintenance information for many different types of systems is provided. The format in which it is presented is generic, to facilitate its use in any documentation system selected. Each system starts on a new page, and is at most 2 pages long. This will facilitate copying (on both sides of a single sheet of paper if that is convenient) information concerning specific systems onto single sheets of paper for distribution to staff and others as appropriate. The information could be part of the scope of work required of maintenance contractors.

In the preventive maintenance schedules, the section on “Inventory Information” provides guidance on which equipment is required to have inventory information recorded according to Section 4.78 of the WCB OH & S Regulation.

DEFINITIONS

Throughout this document, preventive maintenance tasks for ventilation systems are listed according to various major components of those systems. The definitions which follow are intended to clarify what each of these major ventilation system components consists of, at least for the purpose of this document.

Air-side:
The portions of an air-handling unit, packaged A/C or heat pump unit, furnace, or other equipment through which air flows. These components include (as applicable): return air, relief air, and outside air dampers; mixing plenum or chamber; return fan; air filters; internal plenum or ducting leading to the supply fan; and the supply fan. In addition, for multizone units, the hot deck and cold deck plenums or ducts and the zone mixing dampers would be included.

DX Cooling Section:
This includes a direct expansion (DX) cooling coil, located in the air stream of the air-handling unit, plus the air-cooled refrigeration compressor/condensing unit which supplies the coil with cooling. In a packaged system, the condensing unit will be included as an integral part of the air-handling unit or rooftop unit. But in split-systems the condensing unit will be a separate package, connected to the cooling coil by refrigerant piping. This definition applies to both configurations.

Chilled Water Cooling Coil:
This includes a chilled water cooling coil, located in the air stream of the air-handling unit, plus the control valve which acts to modulate the coil’s cooling capacity to meet demand. If there is a circulating pump dedicated to this coil, it is also included.

Fossil-fuel Fired Heating Section:
This consists of a fossil-fuel burner (including associated safety and operating controls), a heat exchanger located in the air-handling unit’s air stream, and the

flue gas venting system. This definition also applies to the burner, heat exchanger and venting for a forced air furnace.

Hot Water Heating Coil:
This includes a hot water heating coil, located in the air stream of the air-handling unit, plus the control valve which acts to modulate the coil's heating capacity to meet demand. If there is a circulating pump dedicated to this coil, it is also included.

Electric Resistance Heating Element(s):
This includes the electric resistance element(s), plus all related safety (e.g. air flow proving switches, overloads, etc.) and operating controls.

MANDATORY PREVENTIVE MAINTENANCE STANDARD

1. HOT WATER HEATING SYSTEM

1.1 Definition

A hot water (HW) heating system typically consists of a boiler (or boilers), a piping distribution system, circulating pumps, control valves (CV's) which modulate system supply temperature or zone water flows, differential pressure control valves (for systems with 2-way zone CV's), and various miscellaneous components (manual shut-off valves, strainers, drains, air vents, air separators, water make-up station, and expansion tank).

Because hot water heating systems do not typically include a ventilation component, the WCB Regulation carries no requirement for preventive maintenance except for flue gas vent and fossil-fuel burner maintenance.

1.2 Inventory Information

What follows is equipment inventory information required by Section 4.9 (2) (a) of the WCB OH & S Regulation. Additional recommended inventory information is included in Appendix 'A'.

(a) For each boiler:

1. energy source (gas, oil, propane, electric resistance, etc.)
2. manufacturer
3. model no. and serial no.

(b) Other Equipment in Hot Water Heating Systems:

1. there are no inventory requirements.

1.3 Preventive Maintenance Tasks

What follows are preventive maintenance tasks required by Section 4.78 (2) of the WCB OH & S Regulation. Additional preventive maintenance tasks which

may be required under other Regulations or as part of good facility management practice are included in Appendix 'A'.

(a) For each fossil-fuel fired boiler:

1. Visually inspect boiler and observe combustion operation - monthly during heating season.
2. Inspection, calibration, repair (as needed), and testing of fuel burners, documenting results - at the start of each heating season.
3. Check operation of the flue gas venting system to ensure it is not leaking, and that flue gases are not back-drafting or being recirculated to any ventilation air intakes.

2. WATER-COOLED CHILLED WATER SYSTEM

2.1 Definition

Chilled water systems are usually only found in quite large buildings. They generate chilled water and supply it to cooling coils. Cooling coils may be in central air-handling units, in packaged fan-coil units, or in other equipment.

A water-cooled, chilled water plant typically consists of: a packaged, water-cooled chiller (or chillers); a condensing water piping system; a cooling tower (or towers) for heat rejection; a chemical/biological water treatment equipment installation for condensing water; a chilled water distribution system; condensing and chilled water pumps; CV's at each cooling coil; and misc. components (manual shut-off valves, strainers, drains, air vents, water make-up station, and expansion tank).

2.2 Inventory Information

What follows is equipment inventory information required by Section 4.9 (2) (a) of the WCB OH & S Regulation. Additional recommended inventory information is included in Appendix 'A'.

(a) For each chiller:

1. type of refrigeration compressor(s) used (e.g. reciprocating, helical screw, or centrifugal)
2. manufacturer
3. model no. and serial no.

(b) For each cooling tower:

1. basic design (e.g. blow-through, draw-through)
2. manufacturer
3. model no. and serial no.

2.3 Preventive Maintenance Tasks

What follows are preventive maintenance tasks required by Section 4.78 (2) of the WCB OH & S Regulation. Additional preventive maintenance tasks which may be required under other Regulations or as part of good facility management practice are included in Appendix 'A'.

(a) For each chiller:

1. there are no preventive maintenance requirements.

(b) For cooling towers (and condensing water system):

1. Maintain effective water treatment to control biological growth anywhere in the cooling towers or condensing water system - visually inspect water treatment operation at least weekly during the cooling season; if there is any evidence of biological growth, clean and disinfect the areas affected. Review the water treatment program, and make revisions to avoid a recurrence.
2. Test water samples to confirm conditions for avoidance of biological growth, corrosion or precipitation (or send them to a lab for tests) - at least monthly during the cooling season.

(c) Other components:

1. there are no preventive maintenance requirements.

3. SINGLE-ZONE PACKAGED ROOFTOP AIR CONDITIONING SYSTEM

3.1 Definition

A single-zone packaged rooftop air conditioning system serves a single thermostatically controlled zone in the building. The system consists of a rooftop air conditioning unit, a supply duct distribution system with room diffusers or grilles, a means for return air to get back to the rooftop unit or to be relieved to outside the building, and provision for outdoor air supply to the unit. The rooftop air conditioning unit itself will typically consist of outdoor air and return air dampers, air filters, a heating section (usually a gas-fired furnace; sometimes an electric resistance coil), a direct expansion (DX) cooling coil (supplied from an air-cooled refrigeration system located within the roof-top unit package), a supply fan (there is rarely a return fan in single-zone units), and internal ducting, all contained within a weather-resistant sheet metal enclosure.

Because such a system provides ventilation, as well as heating and cooling, preventive maintenance is a WCB requirement.

3.2 Inventory Information

What follows is equipment inventory information required by Section 4.9 (2) (a) of the WCB OH & S Regulation. Additional recommended inventory information is included in Appendix ‘A’.

(a) For each packaged rooftop unit:

1. manufacturer
2. model number and serial number.

3.3 Preventive Maintenance Tasks

What follows are preventive maintenance tasks required by Section 4.78 (2) of the WCB OH & S Regulation. Additional preventive maintenance tasks which may be required under other Regulations or as part of good facility management practice are included in Appendix ‘A’.

(a) For each packaged rooftop unit air-side:

1. Change filters - time between filter changes depends on the type of filters, their dust-holding capacity, and the amount of dust in the air. A change interval of from 3 to 6 months will be the normal range.
2. Check all portions of the unit through which air flows for cleanliness and for evidence of standing water or biological growth - every 6 months. Clean as required, and repair any leaks or other uncontrolled sources of water.
3. If there is evidence of biological growth, clean thoroughly and disinfect. If the condensate tray or drain does not drain completely, modify as necessary to ensure that it does.
4. Test operation of any motorized dampers (they should respond to control signal, operate smoothly, and close tightly); clean, lubricate, adjust linkages, or repair as needed - annually.
5. Check operation of gravity (backdraft) dampers; clean, lubricate, or repair as needed - annually.

(b) For each packaged rooftop unit cooling section:

1. Check the cooling coil and its condensate tray and drain - clean as necessary. Ensure that condensate drains completely from the tray, the drain is not blocked, and there is no evidence of biological growth - at the start of each cooling season.
2. If there is evidence of biological growth, clean thoroughly and disinfect. If the condensate tray or drain does not drain completely, modify as necessary to ensure that it does.

(c) For each packaged rooftop unit gas-fired heating section:

1. Inspect, calibrate, repair (as needed), and test fuel burners, including induced draft fan (if applicable) - at the start of each heating season.
2. Check operation of the flue gas venting system to ensure it is not leaking, and that flue gases are not recirculating to any ventilation air intakes.

(d) For each packaged rooftop unit hot water heating coil:

1. Check coil to ensure it is clean; clean as required - annually, as part of general air-side inspection/maintenance.

(e) For each packaged rooftop unit electric resistance heating element:

1. Check element to ensure it is clean; clean as required - annually, as part of general air-side inspection/maintenance.

4. FORCED AIR HEATING/COOLING (FURNACE) SYSTEM

4.1 Definition

This system serves a single thermostatically controlled zone. The basic component of this system is a fossil-fuel fired furnace, consisting of a burner, fan, and filters, all contained in a sheet metal cabinet, typically located in a mechanical room. However it may be located on a mezzanine, in a ceiling plenum, an attic, or other less accessible interior location. Cooling is typically

provided by a DX cooling coil located at the furnace discharge, connected by refrigerant piping to an air-cooled condensing unit located either on the ground outside the building or on the roof of the building.

Outside ventilation air will be provided, either through a fixed outside air connection (a minimum outside air design) or from a modulating damper system which allows the furnace to supply up to 100% outside air to the space (an economizer design). The overall system will also comprise supply and return air ducts, grilles or diffusers for supply air discharges and return air inlets, and controls.

4.2 Inventory Information

What follows is equipment inventory information required by Section 4.9 (2) (a) of the WCB OH & S Regulation. Additional recommended inventory information is included in Appendix 'A'.

(a) For each Furnace:

1. manufacturer,
2. model number and serial number.

4.3 Preventive Maintenance Tasks

What follows are preventive maintenance tasks required by Section 4.78 (2) of the WCB OH & S Regulation. Additional preventive maintenance tasks which may be required under other Regulations or as part of good facility management practice are included in Appendix 'A'.

(a) For each Furnace (includes cooling and ventilation air):

1. Inspect, calibrate, repair (as needed), and test fuel burners, including induced draft fan (if applicable) - at the start of each heating season.
2. Check operation of the flue gas venting system to ensure it is not leaking, and that flue gases are not backdrafting or recirculating to any ventilation air intakes.
3. Change filters - time between filter changes depends on the type of filters, their dust-holding capacity, and the amount of dust in the air. A change interval of from 3 to 6 months will be the normal range.
4. Check all portions of the unit through which air flows (including cooling coil and condensate tray) for cleanliness and for evidence of standing water or biological growth - every 6 months. Clean as required, and repair any leaks or other uncontrolled sources of water.
5. If there is evidence of biological growth, clean thoroughly and disinfect. If the condensate tray or drain does not drain completely, modify as necessary to ensure that it does.
6. Test operation of any motorized dampers (they should respond to control signal, operate smoothly, and close tightly); clean, lubricate, adjust linkages, or repair as needed - annually.
7. Check operation of gravity (backdraft) dampers; clean, lubricate, or repair as needed - annually.

5. VARIABLE AIR VOLUME (VAV) SYSTEM

5.1 Definition

A VAV system consists of a central air handling unit serving multiple thermostatically controlled zones through a supply duct system. The central air handling unit may be either a packaged rooftop unit or a packaged (or built up) air handling unit located in a fan room within the building. The air handling unit has provisions for modulating its supply air flow rate from design maximum down to some minimum (typically using variable speed drives for the fan motor, or fan inlet vanes).

Each zone has a VAV zone terminal (commonly called a "VAV box") in its supply duct. The VAV zone terminal has controls which vary the air flow rate to the zone depending on cooling demand. Many zone terminals also have a reheat coil (either a hot water coil or an electric resistance element) which is controlled in conjunction with the air flow controls to provide heating to the space when it is needed.

Each zone terminal control typically includes a minimum air flow setpoint which is intended to ensure the provision of sufficient outside ventilation air. In addition, the air handling unit outside air and return air damper controls must have a minimum outside air setpoint to ensure that sufficient outside ventilation air is delivered to meet the requirements of all zones served by the system.

5.2 Inventory Information

What follows is equipment inventory information required by Section 4.9 (2) (a) of the WCB OH & S Regulation. Additional recommended inventory information is included in Appendix 'A'.

(a) For each packaged air handling unit:

1. manufacturer
2. model number and serial number.

(b) For each Built-up Air-handling Unit:

If the air handling unit is built up in the field from individual components, then the manufacturer, model number and serial number of components whose performance is critical to good IAQ are required. They will be:

1. Supply fan,
2. Air filters,
3. Fossil-fuel fired heating section (if applicable)

5.3 Preventive Maintenance Tasks

What follows are preventive maintenance tasks required by Section 4.78 (2) of the WCB OH & S Regulation. Additional preventive maintenance tasks which may be required under other Regulations or as part of good facility management practice are included in Appendix 'A'.

The following applies to both packaged and built-up air handling units.

(a) For each Air-handling Unit - Air side:

1. Change filters - time between filter changes depends on the type of filters, their dust-holding capacity, and the amount of dust in the air. A change interval of from 3 to 6 months will be the normal range.
2. Check all portions of the unit through which air flows (including cooling coil and condensate tray) for cleanliness and for evidence of standing water or biological growth - every 6 months. Clean as required, and repair any leaks or other uncontrolled sources of water.
3. If there is evidence of biological growth, clean thoroughly and disinfect. If the condensate tray or drain does not drain completely, modify as necessary to ensure that it does.
4. Test operation of any motorized dampers (they should respond to control signal, operate smoothly, and close tightly); clean, lubricate, adjust linkages, or repair as needed - annually.
5. Check operation of gravity (backdraft) dampers; clean, lubricate, or repair as needed - annually.

(b) For each Air-handling Unit - Fossil-fuel Fired Furnace Heating Section:

1. Inspect, calibrate, repair (as needed), and test fuel burners, including induced draft fan (if applicable) - at the start of each heating season.
2. Check operation of the flue gas venting system to ensure it is not leaking, and that flue gases are not backdrafting or recirculating to any ventilation air intakes.

(c) For each Air-handling Unit - Hot Water Heating Coil:

1. Check coil to ensure it is clean; clean as required - annually, as part of general air-side inspection.

(d) For each Air-handling Unit - Electric Resistance Heating Element:

1. Check element to ensure it is clean; clean as required - annually, as part of general air-side inspection.

(e) For each Air-handling Unit - Integral DX Cooling Section:

1. Ensure water drains completely from the condensate tray and the drain is not blocked - at the start of each cooling season.

(f) For each Air-handling Unit - Chilled Water Cooling Coil:

1. Covered under air-side inspection and maintenance.

(g) For each VAV Terminal Unit:

1. there are no preventive maintenance requirements.

6. MULTIZONE SYSTEM

6.1 Definition

Each multizone system serves multiple thermostatically controlled zones. Within the central air-handling unit, discharge air from the supply fan is split into two parallel paths, the cold deck (which has a cooling coil or, rarely, local DX cooling) and the hot deck (which has a heating coil or, rarely, a fossil-fuel fired furnace

section) The Corporation does have a few "triple deck" multizones, which have a cold deck, a neutral deck (neither heated nor cooled), and a hot deck. Multizone systems usually have constant supply air flow rate. However, the hot deck and cold deck flow rates will vary widely, depending on the demand for heating or cooling.

The supply air to each zone is a mixture of hot deck and cold deck air. The proportion of each is controlled by zone mixing dampers (which are part of the air handling unit) to meet the heating or cooling needs of the zone.

6.2 Inventory Information

What follows is equipment inventory information required by Section 4.9 (2) (a) of the WCB OH & S Regulation. Additional recommended inventory information is included in Appendix 'A'.

(a) For each Packaged Multizone Air-handling Unit:

1. manufacturer
2. model number and serial number.

(b) For each Built-up Air-handling Unit:

If the air handling unit is built up in the field from individual components, then the manufacturer, model number and serial number of components whose performance is critical to good IAQ are required. They will be:

1. Supply fan,
2. Air filters,
3. Fossil-fuel fired heating section (if applicable)

6.3 Preventive Maintenance Tasks

What follows are preventive maintenance tasks required by Section 4.78 (2) of the WCB OH & S Regulation. Additional preventive maintenance tasks which may be required under other Regulations or as part of good facility management practice are included in Appendix 'A'.

The following applies to both packaged and built-up air handling units.

(a) For each Multizone Air-handling Unit - Air side:

1. Change filters - time between filter changes depends on the type of filters, their dust-holding capacity, and the amount of dust in the air. A change interval of from 3 to 6 months will be the normal range.
2. Check all portions of the unit through which air flows (including cooling coil and condensate tray) for cleanliness and for evidence of standing water or biological growth - every 6 months. Clean as required, and repair any leaks or other uncontrolled sources of water.
3. If there is evidence of biological growth, clean thoroughly and disinfect. If the condensate tray or drain does not drain completely, modify as necessary to ensure that it does.
4. Test operation of any motorized dampers (they should respond to control signal, operate smoothly, and close tightly); clean, lubricate, adjust linkages, or repair as needed - annually.

5. Check operation of gravity (backdraft) dampers; clean, lubricate, or repair as needed - annually.

(b) For each Multizone Air-handling Unit - Fossil-fuel Fired Furnace Heating Section:

1. Inspect, calibrate, repair (as needed), and test fuel burners, including induced draft fan (if applicable) - at the start of each heating season.
2. Check operation of the flue gas venting system to ensure it is not leaking, and that flue gases are not backdrafting or recirculating to any ventilation air intakes.

(c) For each Multizone Air-handling Unit - Hot Water Heating Coil:

1. Check coil to ensure it is clean; clean as required - annually, as part of general air-side inspection.

(d) For each Multizone Air-handling Unit - Electric Resistance Heating Element:

1. Check element to ensure it is clean; clean as required - annually, as part of general air-side inspection.

(e) For each Multizone Air-handling Unit - Integral DX Cooling Section:

1. Ensure water drains completely from the condensate tray and the drain is not blocked - at the start of each cooling season.

(f) For each Multizone Air-handling Unit - Chilled Water Cooling Coil:

1. Covered under air-side inspection and maintenance.

7. DUAL-DUCT (or DUAL-FAN, DUAL-DUCT) SYSTEM

7.1 Definition

A dual-duct system has two separate supply ducts distributing air to each thermostatically controlled zone it serves. One duct is “hot deck”, the other is the “cold deck”. Zone terminal units have two air inlets, one connected to the hot deck, the other to the cold deck, each with a control damper. The zone unit control dampers control the proportions of hot and cold deck air entering the unit in order to meet zone heating or cooling needs.

In a dual-duct system, a single central air-handling unit supplies both the hot duct and the cold duct. In most cases, the air-handling unit will be designed to supply up to 100% outside air when conditions permit (economizer operation). In a dual-fan, dual-duct system, the hot duct and cold duct will each be supplied from separate air handling units. This reduces energy use as the amount of outside air delivered through each AH unit’s outside air flow rate can be optimized to minimize the heating energy (hot duct) or cooling energy (cold duct) required.

7.2 Inventory Information

What follows is equipment inventory information required by Section 4.9 (2) (a) of the WCB OH & S Regulation. Additional recommended inventory information is included in Appendix ‘A’.

(a) For each packaged air handling unit:

1. manufacturer
2. model number and serial number.

(b) For each Built-up Air-handling Unit:

If the air handling unit is built up in the field from individual components, then the manufacturer, model number and serial number of components whose performance is critical to good IAQ are required. They will be:

1. Supply fan,
2. Air filters,
3. Fossil-fuel fired heating section (if applicable)

7.3 Preventive Maintenance Tasks

What follows are preventive maintenance tasks required by Section 4.78 (2) of the WCB OH & S Regulation. Additional preventive maintenance tasks which may be required under other Regulations or as part of good facility management practice are included in Appendix 'A'.

The following apply to both packaged and built-up air handling units.

(a) For each Air-handling Unit - Air side:

1. Change filters - time between filter changes depends on the type of filters, their dust-holding capacity, and the amount of dust in the air. A change interval of from 3 to 6 months will be the normal range.
2. Check all portions of the unit through which air flows (including cooling coil and condensate tray) for cleanliness and for evidence of standing water or biological growth - every 6 months. Clean as required, and repair any leaks or other uncontrolled sources of water.
3. If there is evidence of biological growth, clean thoroughly and disinfect. If the condensate tray or drain does not drain completely, modify as necessary to ensure that it does.
4. Test operation of any motorized dampers (they should respond to control signal, operate smoothly, and close tightly); clean, lubricate, adjust linkages, or repair as needed - annually.
5. Check operation of gravity (backdraft) dampers; clean, lubricate, or repair as needed - annually.

(b) For each Air-handling Unit - Fossil-fuel Fired Furnace Heating Section (will not apply to a dual-fan, dual-duct cooling unit):

1. Inspect, calibrate, repair (as needed), and test fuel burners, including induced draft fan (if applicable) - at the start of each heating season.
2. Check operation of the flue gas venting system to ensure it is not leaking, and that flue gases are not backdrafting or recirculating to any ventilation air intakes.

(c) For each Air-handling Unit - Hot Water Heating Coil Section (will not apply to a dual-fan, dual-duct cooling unit):

1. Check coil to ensure it is clean; clean as required - annually, as part of general air-side inspection.

(d) For each Air-handling Unit - Electric Resistance Heating Element Section (will not apply to a dual-fan, dual-duct cooling unit):

1. Check element to ensure it is clean; clean as required - annually, as part of general air-side inspection.

(e) For each Air-handling Unit - Integral DX Cooling Section Section (will not apply to a dual-fan, dual-duct heating unit):

1. Ensure water drains completely from the condensate tray and the drain is not blocked - at the start of each cooling season.

(f) For each Air-handling Unit - Chilled Water Cooling Coil Section (will not apply to a dual-fan, dual-duct heating unit):

1. Covered under air-side inspection and maintenance.

(g) For each Dual-duct Zone Terminal Unit:

1. there are no preventive maintenance requirements.

8. PACKAGED AIR-TO AIR HEAT PUMP SYSTEM

8.1 Definition

Air-to-air heat pumps are refrigeration systems which have a reversing valve which changes the flow of refrigerant such that the system may provide either heating or cooling. Air-to-air heat pump systems may be either packaged systems, or split systems. They typically serve a single thermostatically controlled zone.

Packaged systems will have air handling, refrigeration, and supplementary heating all within a single, packaged unit. often a rooftop unit.

8.2 Inventory Information

What follows is equipment inventory information required by Section 4.9(2)(a) of the WCB OH & S Regulation. Additional recommended inventory information is included in Appendix ‘A’.

(a) For each Packaged Heat Pump System:

1. manufacturer
2. model number and serial number.

8.3 Preventive Maintenance Tasks

What follows are preventive maintenance tasks required by Section 4.78(2) of the WCB OH & S Regulation. Additional preventive maintenance tasks which may be required under other Regulations or as part of good facility management practice are included in Appendix ‘A’.

(a) For each packaged heat pump unit air-side:

1. Change filters - time between filter changes depends on the type of filters, their dust-holding capacity, and the amount of dust in the air. A change interval of from 3 to 6 months will be the normal range.

2. Check all portions of the unit through which air flows for cleanliness and for evidence of standing water or biological growth - every 6 months. Clean as required, and repair any leaks or other uncontrolled sources of water.
3. Test operation of any motorized dampers (they should respond to control signal, operate smoothly, and close tightly); clean, lubricate, adjust linkages, or repair as needed - annually.
4. Check operation of gravity (backdraft) dampers; clean, lubricate, or repair as needed - annually.

(b) For each packaged heat pump unit cooling section:

1. Check the cooling coil and its condensate tray and drain - clean as necessary. Ensure that condensate drains completely from the tray, the drain is not blocked, and there is no evidence of biological growth - at the start of each cooling season.
2. If there is evidence of biological growth, clean thoroughly and disinfect. If the condensate tray or drain does not drain completely, modify as necessary to ensure that it does.

(c) For each packaged heat pump unit gas-fired supplementary heating section:

1. Inspect, calibrate, repair (as needed), and test fuel burners, including induced draft fan (if applicable) - at the start of each heating season.
2. Check operation of the flue gas venting system to ensure it is not leaking, and that flue gases are not backdrafting or recirculating to any ventilation air intakes.

(d) For each packaged heat pump unit supplementary heating by hot water heating coil:

1. Check coil to ensure it is clean; clean as required - annually, as part of general air-side inspection/maintenance.

(e) For each packaged heat pump unit electric resistance supplementary heating element:

1. Check element to ensure it is clean; clean as required - annually, as part of general air-side inspection/maintenance.

9. SPLIT-SYSTEM AIR-TO AIR HEAT PUMP SYSTEMS

9.1 Definition

Air-to-air heat pumps are refrigeration systems which have a reversing valve which changes the flow of refrigerant such that the system may provide either heating or cooling. Air-to-air heat pump systems may be either packaged systems, or split systems. They typically serve a single thermostatically controlled zone.

Split systems are very similar to the forced air heating/cooling systems described earlier (see system #4). The difference is that the “cooling coil” can also act as a heating coil when the heat pump is providing heating. As the outside

temperature gets colder, the heat pump's heat output reduces. Therefore, heat pump systems typically need some sort of supplementary heat source. A furnace (either fossil-fuel fired or electric resistance) is often used for this purpose.

9.2 Inventory Information

What follows is equipment inventory information required by Section 4.9 (2) (a) of the WCB OH & S Regulation. Additional recommended inventory information is included in Appendix 'A'.

(a) For the air-side portion of each Split Heat Pump System:

1. manufacturer
2. model number and serial number.

9.3 Preventive Maintenance Tasks:

What follows are preventive maintenance tasks required by Section 4.78 (2) of the WCB OH & S Regulation. Additional preventive maintenance tasks which may be required under other Regulations or as part of good facility management practice are included in Appendix 'A'.

(a) For each Split-system Heat Pump (includes supplementary heat and ventilation air):

1. If the supplementary heat is from a fossil-fuel fired furnace:
   - Inspect, calibrate, repair (as needed), and test fuel burners, including induced draft fan (if applicable) - at the start of each heating season.
   - Check operation of the flue gas venting system to ensure it is not leaking, and that flue gases are not backdrafting or recirculating to any ventilation air intakes.
2. Change filters - time between filter changes depends on the type of filters, their dust-holding capacity, and the amount of dust in the air. A change interval of from 3 to 6 months will be the normal range.
3. Check all portions of the unit through which air flows for cleanliness and for evidence of standing water or biological growth - every 6 months. Clean as required, and repair any leaks or other uncontrolled sources of water.
4. For refrigerant heating/cooling coil: Check it and the condensate tray and drain - clean as necessary,. Ensure that condensate drains completely from the tray, the drain is not blocked, and there is no evidence of biological growth - at the start of each cooling season.
5. If there is evidence of biological growth, clean thoroughly and disinfect. If the condensate tray or drain does not drain completely, modify as necessary to ensure that it does.
6. Outside air: Test operation of any motorized dampers (they should respond to control signal, operate smoothly, and close tightly); clean, lubricate, adjust linkages, or repair as needed - annually.
7. Check operation of any gravity (backdraft) dampers; clean, lubricate, or repair as needed - annually.

10. WATER-LOOP HEAT PUMP SYSTEMS

10.1 Definition

A water-loop heat pump system uses individual air-to-water heat pumps located throughout a building to provide heating and cooling to the building. The air-side of each heat pump delivers air to the occupied space. The water-side is piped to a common "water-loop". When a heat pump is heating, its water-side is removing heat from the water loop, thus cooling it. When it is cooling, its water-side is rejecting heat to the water loop, heating it. The position of the heat pump's reversing valve determines whether it is heating or cooling.

The central water loop system consists of a pipe distribution system, circulating pumps, a means to add heat to the water loop (usually a boiler) and a means to reject heat from the water loop to the outside air (usually a closed-circuit, evaporatively cooled heat rejector or an open-circuit cooling tower).

The water-loop heat pumps recirculate air only; outside ventilation air has to be provided by means of a separate ventilation system, which will typically provide tempered air to the vicinity of each water-loop heat pump unit. The preventive maintenance requirements of the ventilation system will be similar to those of a VAV system, except it will be constant volume and not have any VAV zone terminal units.

10.2 Inventory Information

What follows is equipment inventory information required by Section 4.9 (2) (a) of the WCB OH & S Regulation. Additional recommended inventory information is included in Appendix 'A'.

(a) For each supplementary heat boiler:

1. energy source (gas, oil, propane, electric resistance, etc.)
2. manufacturer
3. model no. and serial no.

(b) For each heat rejector or cooling tower:

1. basic design (closed-circuit or open; blow through or draw through)
2. manufacturer
3. model no. and serial no.

(c) For each heat pump unit:

1. manufacturer
2. model no. and serial no.

10.3 Preventive Maintenance Tasks

What follows are preventive maintenance tasks required by Section 4.78 (2) of the WCB OH & S Regulation. Additional preventive maintenance tasks which may be required under other Regulations or as part of good facility management practice are included in Appendix 'A'.

(a) For each Heat Pump:

1. Change filters - time between filter changes depends on the type of filters, their dust-holding capacity, and the amount of dust in the air. A change interval of from 3 to 6 months will be the normal range.
2. Check all portions of the unit through which air flows (including cooling coil and condensate tray) for cleanliness and for evidence of standing water or biological growth - every 6 months. Clean as required, and repair any uncontrolled sources of water.
3. If there is evidence of biological growth, clean thoroughly and disinfect. If the condensate tray or drain does not drain completely, modify as necessary to ensure that it does.

(b) For each Evaporative Heat Rejector or Cooling Tower:

1. Maintain effective water treatment to control biological growth in the basin and recirculating water system - visually inspect water treatment operation at least weekly during the cooling season; if there is any evidence of biological growth, clean and disinfect the areas affected. Review the water treatment program, and make revisions to avoid a recurrence.
2. Test water samples to confirm conditions for avoidance of biological growth, corrosion or precipitation (or send them to a lab for tests) - at least monthly during the cooling season.

11. PACKAGED TERMINAL AIR CONDITIONING (PTAC) UNITS

11.1 Definition

This is the term used to describe air-cooled cooling units which are installed through a wall, using a wall sleeve. It is also applied to window cooling units, which are installed in part of a window opening. These units recirculate room air, cooling it before discharging it back into the room. They provide no outside air ventilation.

11.2 Inventory Information

What follows is equipment inventory information required by Section 4.9 (2) (a) of the WCB OH & S Regulation. Additional recommended inventory information is included in Appendix ‘A’.

(a) For each PTAC:

1. manufacturer,
2. model no. and serial no.

11.3 Preventive Maintenance Tasks

What follows are preventive maintenance tasks required by Section 4.78 (2) of the WCB OH & S Regulation. Additional preventive maintenance tasks which may be required under other Regulations or as part of good facility management practice are included in Appendix ‘A’.

(a) For each PTAC:

1. Change filters - time between filter changes depends on the type of filters, their dust-holding capacity, and the amount of dust in the air. A change interval of from 3 to 6 months will be the normal range.
2. Check the interior of the unit, including condensate tray and drain, for dirt or moisture buildup - clean as necessary. Ensure that condensate drains completely from the tray, the drain is not blocked, and there is no evidence of biological growth - at the start of each cooling season.
3. If there is evidence of biological growth, clean thoroughly and disinfect. If the condensate tray or drain does not drain completely, modify as necessary to ensure that it does.

12. SPLIT-SYSTEM COOLING SYSTEM

12.1 Definition

This is a cooling only system comprising an exterior compressor/condensing package and one or more interior fan-coil units. The fan-coil units contain a DX cooling coil which is connected to the exterior package by refrigerant piping. As with PTAC units, the fan-coil units merely recirculate and cool room air; they provide no outside ventilation air. The exterior units are air-cooled condensing packages, similar to those used in other types of split-system refrigeration equipment.

12.2 Inventory Information

What follows is equipment inventory information required by Section 4.9 (2) (a) of the WCB OH & S Regulation. Additional recommended inventory information is included in Appendix 'A'.

(a) For each DX cooling fan-coil unit:

1. manufacturer,
2. model no. and serial no.

12.3 Preventive Maintenance Tasks

What follows are preventive maintenance tasks required by Section 4.78 (2) of the WCB OH & S Regulation. Additional preventive maintenance tasks which may be required under other Regulations or as part of good facility management practice are included in Appendix 'A'.

(a) For each DX cooling fan-coil unit:

1. Change filters - time between filter changes depends on the type of filters, their dust-holding capacity, and the amount of dust in the air. A change interval of from 3 to 6 months will be the normal range.
2. Check the interior of the unit, including condensate tray and drain, for dirt or moisture buildup - clean as necessary. Ensure that condensate drains completely from the tray, the drain is not blocked, and there is no evidence of biological growth - at the start of each cooling season.
3. If there is evidence of biological growth, clean thoroughly and disinfect. If the condensate tray or drain does not drain completely, modify as necessary to ensure that it does.

13. HUMIDIFIERS and DIRECT EVAPORATIVE COOLERS

13.1 Definition

Humidifiers are devices which add water vapour to a ducted air stream or directly to a space in order to increase its relative humidity. There are a variety of different types of humidifiers. However, any type which includes open water containers or which uses an evaporative medium which is in direct contact with the air, is a potential source of contaminants and biological growth. Mandatory preventive maintenance requirements apply to these.

When an evaporative medium is used (e.g. a porous pad in the air stream, which is wetted, and from which water is vapourized into the air stream), then the energy taken from the air stream to vapourize the water will also cool the air. Hence such installations are sometimes used for direct evaporative cooling purposes, in addition to providing humidification. Direct evaporative cooling is what is called an isenthalpic process. The air stream's dry-bulb temperature is reduced (cooling effect) while at the same time its humidity is increased; the net effect is a cooler, more humid airstream which has the same enthalpy (or energy content) as the original airstream.

13.2 Inventory Information

What follows is equipment inventory information required by Section 4.9 (2) (a) of the WCB OH & S Regulation. Additional recommended inventory information is included in Appendix 'A'.

(a) For each humidifier (or evaporative cooling pad or coil):

1. basic type (e.g. open heated pan, evaporative pad rotating in a pan, fixed evaporative pad, sprayed coil, steam generating canister)
2. manufacturer
3. model no. and serial no.

11.3 Preventive Maintenance Tasks

What follows are preventive maintenance tasks required by Section 4.78 (2) of the WCB OH & S Regulation. Additional preventive maintenance tasks which may be required under other Regulations or as part of good facility management practice are included in Appendix 'A'.

(a) For each evaporative pad or sprayed coil humidifier:

1. Inspect humidifier pan or signs of particulate build-up or biological growth - at least monthly during heating season. Clean as needed (may require vigorous mechanical cleaning). If there are signs of biological growth, both clean and disinfect, and in addition, increase the frequency of subsequent inspections.
2. Inspect evaporative pads (or coils) for cleanliness and signs of biological growth - at least monthly during heating season. Spray clean (and disinfect if there is biological growth) as needed.
3. Ensure evaporative pads (or coils) are dry during fan shut-off times - modify controls or installation if needed to achieve this.

(b) For each heated pan humidifier:

1. Inspect humidifier pan or signs of particulate build-up or biological growth - at least monthly during heating season. Clean as needed (may require vigorous mechanical cleaning). If there are signs of biological growth, both clean and disinfect, and in addition, increase the frequency of subsequent inspections.

(c) For each canister humidifier:

1. Inspect steam discharge area for signs of dampness or biological growth - at least monthly during heating season. Clean and disinfect as needed, and modify controls or installation to prevent a recurrence.
2. Inspect particulate buildup within canister - at least monthly during heating season. Replace canister, or clean it (depending on design) as required.

14. AIR-TO-AIR HEAT EXCHANGERS

14.1 Definition

In cold weather, air-to-air heat exchangers recover heat from warm exhaust air and transfer it to incoming outside air, thus pre-heating the outside air and reducing the energy required to heat it to the temperature at which it is supplied to occupied space. In hot weather, they can cool down incoming outside air.

Air-to-air heat exchangers come in a variety of configurations. There are “heat” wheels, located half in an exhaust air stream and half in an outside air stream, constructed of a porous heat conducting material through which air can flow. Hot air will give up some of its heat to the wheel material; cold air will be warmed by removing some heat from the wheel material.

There are honeycomb designs, in which exhaust air and outside air flow in different directions in adjoining passages in the honeycomb. Heat flows from the warm air side to the cold air side. Products known as “heat recovery ventilators” are usually of this configuration. The internal honeycomb may be removable for cleaning or replacement.

There are heat pipes. They look like a conventional water coil (each pipe “row” is a separate heat pipe), but without any external water connections. The exhaust and outside air ducts are located side-by-side, with half the heat pipe unit located in each duct. Each heat pipe is sealed, has a capillary membrane on the interior surface of the pipe, and is charged with a “fill” material, often a refrigerant, which will vaporize and condense at the hot and cold temperatures respectively in the two ducts. In cold weather, the warm exhaust air will vaporize the “fill”, which adds to its heat content. The vapour flows to the other end of the heat pipe where it is condensed by the cold outside air passing over the outside of the heat pipe (and giving up its heat of vapourization in the process, thus heating the outside air). After it is condensed, it flows up the capillary material (as a liquid) to the other end where it is once again vapourized.

There are also so-called “runaround coils” and heat pump based systems. However, this section will only discuss the first two types of configuration.

14.2 Inventory Information

What follows is equipment inventory information required by Section 4.9 (2) (a) of the WCB OH & S Regulation. Additional recommended inventory information is included in Appendix 'A'.

(a) For each heat exchanger unit:

1. manufacturer
2. model no. and serial no.

14.3 Preventive Maintenance Tasks

What follows are preventive maintenance tasks required by Section 4.78 (2) of the WCB OH & S Regulation. Additional preventive maintenance tasks which may be required under other Regulations or as part of good facility management practice are included in Appendix 'A'.

(a) For each "heat wheel" unit:

1. Measure pressure drop across both exhaust and outside air sides ; this is an indication of dirt accumulation within the unit, which can impair air flow - annually.
2. Inspect to ensure it is clean, and there are no signs of persistent moisture or biological growth - annually. Clean as needed; disinfect if there is biological growth present. Take steps to eliminate conditions leading to persistent moisture presence.

(b) For each "honeycomb" unit:

1. Inspect to ensure it is clean, and there are no signs of persistent moisture or biological growth - annually. Clean as needed; disinfect if there is biological growth present. Replace honeycomb portion of unit if cleaning not practical. Take steps to eliminate conditions leading to persistent moisture presence.

APPENDIX ‘A’

B.C. Buildings Corporation

Recommended Inventory Data and Preventive Maintenance Tasks

BC Buildings Corporation

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APPENDIX A

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APPENDIX 'A' - RECOMMENDED INVENTORY DATA AND PREVENTIVE MAINTENANCE TASKS

A1. HOT WATER HEATING SYSTEM

A1.2 Inventory Information

The following inventory information is not required by Section 4.9 (2) (a) of the WCB OH & S Regulation, but is recommended as good facility management practice.

(a) For each boiler:

1. input and output capacities
2. design working pressure
3. boiler inspection certificate #

(b) It is recommended that inventory information also be available for the following components of a typical HW heating system:

1. each circulating pump,
2. the water make-up station, including backflow prevention device,
3. each system 3-way control valve (CV) - (A "system" CV is positioned to control something affecting many individual temperature control zones. For example, it could control the mixing of return and boiler water to vary the supply water temperature according to outside air temperature.)
4. zone 2-way CV's

A1.3 Preventive Maintenance Tasks

The following preventive maintenance tasks are not required by Section 4.78 (2) of the WCB OH & S Regulation, but may be required under other Regulations or are recommended as good facility management practice.

(a) For each fossil-fuel fired boiler:

1. List the next scheduled boiler inspection, and document when it is carried out by the boiler inspector.
2. Check operation of safety relief valves.
3. Check that boiler firing is controlled to maintain water supply setpoints as desired - adjust or calibrate as necessary.
4. Check that the combustion air intake is not blocked - clear out as necessary.

(b) In addition, it is recommended that appropriate preventive maintenance schedules be included for the following components:

1. each circulating pump,
2. each "system" 3-way CV,
3. each 2-way CV,
4. each differential pressure control (for systems with variable flow and 2-way zone CV's), and

5. the water make-up station, including the backflow preventer.

A2. WATER-COOLED CHILLED WATER SYSTEM

A2.2 Inventory Information

The following inventory information is not required by Section 4.9 (2) (a) of the WCB OH & S Regulation, but is recommended as good facility management practice.

(a) For each chiller:

1. type of refrigerant (e.g. R11, R22, R123, R134A, etc.)
2. output capacity
3. design chilled water flow,
4. chilled water supply and return temperatures,
5. design condenser water flow,
6. design condensing water outlet (from chiller to tower) and inlet (from tower to chiller) temperatures, and
7. compressor motor hp and electrical data (phases, voltage, and rated amps) - for chillers with multiple compressors, data on each compressor.

(b) For each cooling tower:

1. design condensing water flow,
2. design condensing water inlet (from chiller) and outlet (back to chiller) temperatures,
3. fan motor hp and electrical data (phases, voltage, and rated amps), and if applicable the number of fans. **NOTE**: some cooling towers will have 2-speed fans, or 2 separate fan motors (1 for design operation, the 2nd for half-speed, part-load operation) - include data for each fan motor as appropriate

(c) It is recommended that inventory information also be available for the following components of a typical chilled water system:

1. each chilled water and condensing water pump
2. the water make-up station, including backflow preventer,
3. each CV,
4. condensing water treatment equipment.

A2.3 Preventive Maintenance Tasks

The following preventive maintenance tasks are not required by Section 4.78 (2) of the WCB OH & S Regulation, but may be required under other Regulations or are recommended as good facility management practice.

(a) For each chiller:

1. For centrifugal chillers - a comprehensive preventive maintenance program in accordance with the manufacturer's recommendations.
2. For other chillers - check the operation of the refrigeration system, monitor refrigerant leakage (if any), and service/repair as necessary - at the start of each cooling season.

3. For all chillers - Ensure documentation of refrigerant leakage, usage, etc. as required by Provincial Regulation.

(b) For cooling towers (and condensing water system):

1. Check fan and fan motor bearings; repair/replace as needed - annually.
2. Check fan belt drives (if applicable); adjust or replace belts as needed - annually.

(c) In addition, it is recommended that appropriate preventive maintenance schedules be included for the following components:

1. Chilled water and condensing water pumps.
2. Water make-up station, including the backflow preventer.
3. System control valves, and overall controls operation.

A3. SINGLE-ZONE PACKAGED ROOFTOP AIR CONDITIONING SYSTEM

A3.2 Inventory Information

The following inventory information is not required by Section 4.9 (2) (a) of the WCB OH & S Regulation, but is recommended as good facility management practice.

(a) For each packaged rooftop unit:

1. cooling capacity
2. refrigerant compressor manufacturer
3. type of refrigerant
4. heating capacity
5. heating energy source
6. fan motor hp, rpm, and electrical data (phases, voltage, and rated amps)
7. fan belt specifications
8. design air flow rate and fan total static pressure
9. air filter size, number, and efficiency rating.

A3.3 Inspection and Maintenance Tasks

The following preventive maintenance tasks are not required by Section 4.78 (2) of the WCB OH & S Regulation, but may be required under other Regulations or are recommended as good facility management practice.

(a) For each Rooftop Unit:

1. Check fan and fan motor bearings; repair/replace as needed - annually
2. Check the air-cooled condenser, and clean as necessary - at the start of each cooling season.
3. Check the operation of the refrigeration system, monitor refrigerant leakage (if any), and service/repair as necessary - at the start of each cooling season.
4. Ensure documentation of refrigerant leakage, usage, etc. as required by Provincial Regulation.

(b) Supply and Return Air Duct System:

1. Inspect accessible portions of duct system for cleanliness and evidence of dampness or biological growth; clean as needed - annually. If there is evidence of biological growth, inspect entire system and clean/disinfect.

A4. FORCED AIR HEATING/COOLING (FURNACE) SYSTEM

A4.2 Inventory Information

The following inventory information is not required by Section 4.9 (2) (a) of the WCB OH & S Regulation, but is recommended as good facility management practice.

(a) For each furnace:

1. heating energy source (e.g. gas, oil, electricity),
2. heating capacity,
3. design air flow and total (or external) static pressure,
4. design minimum outside air flow rate.

(b) It is recommended that inventory information also be available for the following components of a typical forced air system:

1. the air-cooled refrigeration system - manufacturer, model no., serial no., type of refrigerant, cooling capacity.

A4.3 Preventive Maintenance Tasks

The following preventive maintenance tasks are not required by Section 4.78 (2) of the WCB OH & S Regulation, but may be required under other Regulations or are recommended as good facility management practice.

(a) For each furnace (includes cooling and ventilation air):

1. Check fan and fan motor bearings; repair/replace as needed - annually
2. Inspect accessible portions of duct system for cleanliness and evidence of dampness or biological growth; clean as needed - annually. If there is evidence of biological growth, inspect entire system and clean/disinfect.
3. Check, and clean as necessary, the air-cooled condenser - at the start of each cooling season.
4. Check the operation of the refrigeration system, monitor refrigerant leakage (if any), and service/repair as necessary - at the start of each cooling season.
5. Ensure documentation of refrigerant leakage, usage, etc. as required by Provincial Regulation.

(b) For supply and return ducts systems:

1. Inspect accessible portions of duct system for cleanliness and evidence of dampness or biological growth; clean as needed - annually. If there is evidence of biological growth, inspect entire system and clean/disinfect as needed.

A5. VARIABLE AIR VOLUME (VAV) SYSTEM

A5.2 Inventory Information

The following inventory information is not required by Section 4.9 (2) (a) of the WCB OH & S Regulation, but is recommended as good facility management practice.

(a) For each packaged air handling unit:

1. cooling capacity
2. refrigerant compressor manufacturer (if DX cooling is provided by a refrigeration system integral to the unit)
3. type of refrigerant (if cooling is provided by a refrigeration system integral to the unit)
4. heating capacity
5. type of heating (e.g. hot water heating coil, integral gas or oil furnace, electric resistance element)
6. fan motor hp, rpm, and electrical data (phases, voltage, and rated amps)
7. fan belt specifications
8. design air flow rate and fan total static pressure
9. design minimum outside air flow rate
10. air filter size, number, and efficiency rating

(b) For each built-up air-handling unit:

1. Data on capacities, air flows, motor hp's, etc., as applicable and listed under packaged AH units above.

(c) It is recommended that inventory information also be available for the following components of a typical VAV system:

1. AH unit heating section (except fossil-fuel fired),
2. AH unit cooling section,
3. AH unit motorized dampers,
4. the manufacturer and model number of each VAV terminal unit,
5. design minimum and maximum flow rates for each VAV terminal unit,
6. design reheat capacity (if applicable) for each VAV terminal unit.

A5.3 Inspection and Maintenance Tasks

The following preventive maintenance tasks are not required by Section 4.78 (2) of the WCB OH & S Regulation, but may be required under other Regulations or are recommended as good facility management practice.

(a) For each air-handling unit - air side:

1. Check fan and fan motor bearings; repair/replace as needed - annually

(b) For each Air-handling Unit - Fossil-fuel Fired Furnace Heating Section:

1. Check condition of the furnace combustion chamber, and clean as needed - at the start of each heating season. If there is any evidence of heat exchanger leakage, repair leaks or replace heat exchanger as indicated.

(c) For each Air-handling Unit - Hot Water Cooling Coil:

1. Check control valve operation (it should respond to control signal, operate smoothly, and close tightly when no cooling is required) - annually.
2. Check circulating pump and motor - annually.

(d) For each Air-handling Unit - Electric Resistance Heating Element:

1. Check operation of all controls, including air flow proving switch - annually

(e) In addition, it is recommended that appropriate preventive maintenance schedules be included for the following components:

1. **For each VAV terminal unit**: Check controls function and damper operation to confirm actual maximum and minimum air flow rates - only if there is persistent evidence of an IAQ problem. This is a significant effort as it involves air flow measurements (i.e. "air balancing") in conjunction with tests of control system response and calibration.
2. **For supply and return air duct systems:** Inspect accessible portions of duct system for cleanliness and evidence of dampness or biological growth; clean as needed - annually. If there is evidence of biological growth, inspect entire system and clean/disinfect as needed.

A6. MULTIZONE SYSTEMS

A6.2 Inventory Information

The following inventory information is not required by Section 4.9 (2) (a) of the WCB OH & S Regulation, but is recommended as good facility management practice.

(a) For each packaged multizone air-handling unit:

1. cooling capacity
2. refrigerant compressor manufacturer (if DX cooling is provided by a refrigeration system integral to the unit)
3. type of refrigerant (if cooling is provided by a refrigeration system integral to the unit)
4. heating capacity
5. type of heating (e.g. hot water heating coil, integral gas or oil furnace)
6. supply fan motor hp, rpm, and electrical data (phases, voltage, and rated amps)
7. fan belt specifications
8. design air flow rate and fan total static pressure
9. design minimum outside air flow rate
10. air filter size, number, and efficiency rating

A6.3 Preventive Maintenance Tasks

The following preventive maintenance tasks are not required by Section 4.78 (2) of the WCB OH & S Regulation, but may be required under other Regulations or are recommended as good facility management practice.

(a) For each Multizone (MZ) Air-handling Unit - air-side:

1. Zone damper linkage adjustment and control, particularly to ensure tight closure - annually.

(b) For each (MZ) Air-handling Unit - Fossil-fuel Fired Furnace Heating Section:

1. Check condition of the furnace combustion chamber, and clean as needed - at the start of each heating season. If there is any evidence of heat exchanger leakage, repair leaks or replace heat exchanger as indicated.

(c) For each (MZ) Air-handling Unit - Hot Water Cooling Coil:

1. Check control valve operation (it should respond to control signal, operate smoothly, and close tightly when no cooling is required) - annually.
2. Check circulating pump and motor - annually.

(d) For each (MZ) Air-handling Unit - Electric Resistance Heating Element:

1. Check operation of all controls, including air flow proving switch - annually

(e) In addition, it is recommended that appropriate preventive maintenance schedules be included for the following components:

1. **For supply (hot and cold) and return ducts systems:** Inspect accessible portions of duct system for cleanliness and evidence of dampness or biological growth; clean as needed - annually. If there is evidence of biological growth, inspect entire system and clean/disinfect as needed.

A7. DUAL-DUCT (or DUAL-FAN, DUAL-DUCT) SYSTEMS

A7.2 Inventory Information

The following equipment inventory information is not required by Section 4.9(2)(a) of the WCB OH & S Regulation, but is recommended as good facility management practice.

(a) For each packaged air handling unit:

1. cooling capacity
2. refrigerant compressor manufacturer (if DX cooling is provided by a refrigeration system integral to the unit)
3. type of refrigerant (if cooling is provided by a refrigeration system integral to the unit)
4. heating capacity
5. type of heating (e.g. hot water heating coil, integral gas or oil furnace, electric resistance element)
6. fan motor hp, rpm, and electrical data (phases, voltage, and rated amps)
7. fan belt specifications
8. design air flow rate and fan total static pressure
9. design minimum outside air flow rate
10. air filter size, number, and efficiency rating

(b) For each built-up air-handling unit:

1. Data on capacities, air flows, motor hp's, etc., as applicable and listed under packaged AH units above.

(c) In addition, it is recommended that appropriate preventive maintenance schedules be included for the following components:

1. the manufacturer and model number of each dual-duct terminal unit,

2. design minimum and maximum air flow rates, both hot duct and cold duct, for each dual-duct zone terminal unit.

A7.3 Preventive Maintenance Tasks

The following preventive maintenance tasks are not required by Section 4.78(2) of the WCB OH & S Regulation, but may be required under other Regulations or are recommended as good facility management practice.

(a) For each Dual-duct Zone Terminal Unit:

1. Check controls function and damper operation to confirm actual maximum and minimum air flow rates, for both hot and cold duct inlets - only if there is persistent evidence of an IAQ problem. This is a significant effort as it involves air flow measurements (i.e. “air balancing”) in conjunction with tests of control system response and calibration.

For supply (hot and cold) and return ducts systems: Inspect accessible portions of duct system for cleanliness and evidence of dampness or biological growth; clean as needed - annually. If there is evidence of biological growth, inspect entire system and clean/disinfect as needed.

A8. PACKAGED AIR-TO AIR HEAT PUMP SYSTEMS

A8.2 Inventory Information

The following inventory information is not required by Section 4.9 (2) (a) of the WCB OH & S Regulation, but is recommended as good facility management practice.

(a) For each packaged air-to-air heat pump unit:

1. cooling capacity
2. refrigerant compressor manufacturer
3. type of refrigerant
4. heating capacity
5. heating energy source
6. fan motor hp, rpm, and electrical data (phases, voltage, and rated amps)
7. fan belt specifications
8. design air flow rate and fan total static pressure
9. air filter size, number, and efficiency rating.

A8.3 Preventive Maintenance Tasks

The following preventive maintenance tasks are not required by Section 4.78 (2) of the WCB OH & S Regulation, but may be required under other Regulations or are recommended as good facility management practice.

(a) For each packaged heat pump unit air-side:

1. Check fan and fan motor bearings; repair/replace as needed - annually
2. Check, and clean as necessary, the outside refrigerant coil - twice a year, at the start of both heating and cooling seasons.

3. Check the operation of the refrigeration system, including reversing valve, monitor refrigerant leakage (if any), and service/repair as necessary - twice a year, at the start of both heating and cooling seasons.
4. Ensure documentation of refrigerant leakage, usage, etc. as required by Provincial Regulation.

(b) For each packaged heat pump unit cooling section:

1. Operation of the refrigerant reversing valve.

(c) For supply and return air duct systems:

1. Inspect accessible portions of duct system for cleanliness and evidence of dampness or biological growth; clean as needed - annually. If there is evidence of biological growth, inspect entire system and clean/disinfect as needed.

A9. SPLIT-SYSTEM AIR-TO AIR HEAT PUMP SYSTEMS

A9.2 Inventory Information

The following inventory information is not required by Section 4.9 (2) (a) of the WCB OH & S Regulation, but is recommended as good facility management practice.

(a) For heat pump cooling and air-side sections:

1. cooling capacity
2. refrigerant compressor manufacturer
3. type of refrigerant
4. heating capacity
5. heating energy source
6. fan motor hp, rpm, and electrical data (phases, voltage, and rated amps)
7. fan belt specifications
8. design air flow rate and fan total static pressure
9. air filter size, number, and efficiency rating.

(b) For each fossil-fuel fired furnace (when used for supplementary heat):

1. heating energy source (e.g. gas, oil, electricity),
2. heating capacity,
3. design air flow and total (or external) static pressure,
4. design minimum outside air flow rate.

A9.3 Preventive Maintenance Tasks

The following preventive maintenance tasks are not required by Section 4.78 (2) of the WCB OH & S Regulation, but may be required under other Regulations or are recommended as good facility management practice.

(a) For each heat pump unit air side:

1. Check fan and fan motor bearings; repair/replace as needed - annually
2. Check, and clean as necessary, the outside refrigerant coil - twice a year, at the start of both heating and cooling seasons.

(b) For each packaged heat pump unit cooling section:

1. Check the operation of the refrigeration system, including reversing valve, monitor refrigerant leakage (if any), and service/repair as necessary - twice a year, at the start of both heating and cooling seasons.
2. Ensure documentation of refrigerant leakage, usage, etc. as required by Provincial Regulation.

(c) For supply and return air duct systems:

1. Inspect accessible portions of duct system for cleanliness and evidence of dampness or biological growth; clean as needed - annually. If there is evidence of biological growth, inspect entire system and clean/disinfect as needed.

A10. WATER-LOOP HEAT PUMP SYSTEMS

A10.2 Inventory Information

The following inventory information is not required by Section 4.9 (2) (a) of the WCB OH & S Regulation, but is recommended as good facility management practice.

(a) For each supplementary heating boiler:

1. input and output capacities
2. design working pressure
3. boiler inspection certificate # (if applicable).

(b) For each heat rejector or cooling tower:

1. design water flow,
2. design water inlet (from water loop) and outlet (back to water loop) temperatures,
3. fan motor hp and electrical data (phases, voltage, and rated amps), and if applicable the number of fans. **NOTE**: some heat rejectors or cooling towers will have 2-speed fans, or 2 separate fan motors (1 for design operation, the 2nd for half-speed, part-load operation) - include data for each fan motor as appropriate

(c) It is recommended that inventory information also be available for the following components of a typical water-loop heat pump system:

1. each water loop circulating pump
2. the water make-up station, including backflow preventer,
3. heat rejector or cooling tower water treatment equipment.

1.3 Inspection and Maintenance Tasks

The following preventive maintenance tasks are not required by Section 4.78 (2) of the WCB OH & S Regulation, but may be required under other Regulations or are recommended as good facility management practice.

(a) For each heat pump unit:

1. Check fan and fan motor bearings; repair/replace as needed - annually
2. Check the operation of the refrigeration system, monitor refrigerant leakage (if any), and service/repair as necessary - every 6 months.

3. Ensure documentation of refrigerant leakage, usage, etc. as required by Provincial Regulation.

(b) For supply and return ducts systems:

1. Inspect accessible portions of duct system for cleanliness and evidence of dampness or biological growth; clean as needed - annually. If there is evidence of biological growth, inspect entire system and clean/disinfect as needed.

A11. PACKAGED TERMINAL AIR CONDITIONING (PTAC) UNITS

A11.2 Inventory Information

The following inventory information is not required by Section 4.9 (2) (a) of the WCB OH & S Regulation, but is recommended as good facility management practice.

(a) For each PTAC unit:

1. cooling capacity
2. refrigerant compressor manufacturer
3. type of refrigerant

A11.3 Preventive Maintenance Tasks

The following preventive maintenance tasks are not required by Section 4.78 (2) of the WCB OH & S Regulation, but may be required under other Regulations or are recommended as good facility management practice.

(a) For each PTAC unit;

1. Check fan and fan motor bearings; repair/replace as needed - annually
2. Check the air-cooled condenser, and clean as necessary - at the start of each cooling season.
3. Check the operation of the refrigeration system, monitor refrigerant leakage (if any), and service/repair as necessary - at the start of each cooling season.
4. Ensure documentation of refrigerant leakage, usage, etc. as required by Provincial Regulation.

A12. SPLIT-SYSTEM COOLING SYSTEMS

A12.2 Inventory Information

The following inventory information is not required by Section 4.9 (2) (a) of the WCB OH & S Regulation, but is recommended as good facility management practice.

(a) For each DX cooling fan-coil unit:

1. cooling capacity

(b) For each exterior condensing package:

1. cooling capacity
2. refrigerant compressor manufacturer
3. type of refrigerant

A12.3 Preventive Maintenance Tasks

The following preventive maintenance tasks are not required by Section 4.78 (2) of the WCB OH & S Regulation, but may be required under other Regulations or are recommended as good facility management practice.

(a) For each DX cooling fan-coil unit:

1. Check fan and fan motor bearings; repair/replace as needed - annually

(b) For each exterior condensing package:

1. Check condenser fan and fan motor bearings; repair/replace as needed - annually
2. Check the air-cooled condenser, and clean as necessary - at the start of each cooling season.
3. Check the operation of the refrigeration system (including indoor coil in fan-coil unit), monitor refrigerant leakage (if any), and service/repair as necessary - at the start of each cooling season.
4. Ensure documentation of refrigerant leakage, usage, etc. as required by Provincial Regulation.