

FUNDAMENTALS OF BUILDING MAINTENANCE

**A Training Course to Provide a Straight Forward, Clear
and Uncomplicated Approach to Building Maintenance**



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INTRODUCTION:

The Purpose of Building Maintenance is not just to “Maintain” Existing Condition of Facilities

The Purpose of Building Maintenance is to improve the condition of facilities for the benefit and especially the Health and Safety of the building occupants.

Building Maintenance helps to ensure facilities and all related components (Assets) achieve their Maximum Lifecycle Expectancy (MLE) and stop further deterioration of a component.

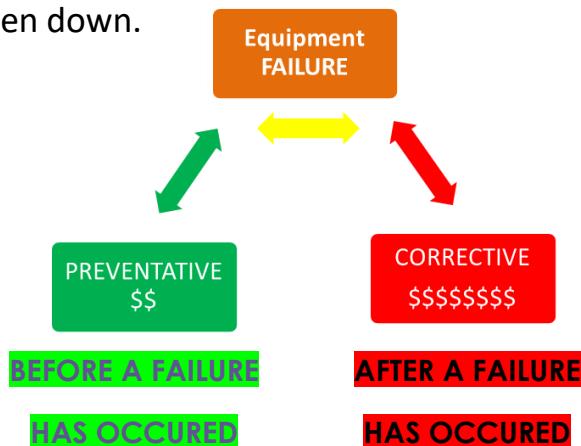
Long-term benefits for Building Owners of proper building maintenance are:

- Reduced Maintenance, and
- Reduced Expenditures, and
- Reduced Costs

Building Maintenance also assists and supports in developing 1 Year, 3 Year, 5 year & 10 Year Capital Improvement and Replacement Plans.

Proper Building Maintenance is always Proactive NOT Reactive or Corrective Maintenance.

Reactive/Corrective/Breakdown Maintenance is only repairing or replacing an Asset after it is broken down.



DEFINITIONS:

1. Assets:

Physical Assets for Facility Management are all related Building structures, components, equipment & parts. Examples of Physical Assets Includes, but not limited to; Building Structure, Roofs, Doors, Windows, Parking lots, Lights, Boilers, Furnaces, Motors, Pumps, Hot Water Tanks, etc.

2. Preventative Maintenance (PM):

Defined as regularly scheduled inspections, tests, servicing, replacements, repairs and other tasks intended to help reduce the impact and frequency of equipment failures.

3. Predictive Maintenance:

Predictive Maintenance could be considered “Advanced” Preventative Maintenance. Predictive Maintenance utilizes advanced equipment and methods to “Predict” future equipment breakdowns. Thermal imaging, vibration detectors oil analysis, Boiler Water Sampling and other methods are used to better determine potential failures and breakdown of equipment. Predictive Maintenance should not be considered “separate” from Preventative Maintenance as many Predictive Maintenance tests assist in Preventative Maintenance.

4. Corrective Maintenance (Reactive or Breakdown Maintenance):

Occurs after an asset has failed. It is designed to identify and “Correct” the failed component by repair or replacement and place it back into operation. Corrective Maintenance is Often a result of **“Run to Fail”** Directives.

SAFETY:



Building maintenance requires access to areas and equipment where mandatory safety training, attention, Personal Protective Equipment (PPE) and other safety precautions are required.

Do not compromise at any time - personal or employee safety in order to observe or complete any building maintenance tasks.

Always wear proper PPE, including, but not limited to:

- Hard hats:
 - Should be worn in mechanical rooms, crawl spaces, areas with low ceilings/roofs/access hatches
- Safety googles:
 - Safety googles/glasses should be worn at all times when performing any building maintenance especially in mechanical areas, working with any chemicals and in areas with potential rodent infestation
- Reflective vests,
- Respirators/Masks:
 - Respiratory apparatuses should be worn in crawl spaces, while using boiler chemicals, janitorial chemical & supplies, where potential rodent infestation areas, and in Indoor Air Quality (IAQ) problem areas
- Proper clothing,
- Gloves, and
- Fall protection equipment.

Ensure that for any high or elevated work that all personal have received certified ladder safety training and are following all proper safety procedures for ladders (4-1 rule & extend 3 feet higher than roof). Elevated work on roofs includes safe distance from any edge (2 meters or 6 feet) or personal fall arrest protection equipment

When working around any electrical device or component, ensure that any and all electrical power is turned off and proper lockout/tagout procedures are in place.

MECHANICAL AND HEATING, VENTILATION AND AIR CONDITIONING (HVAC) EQUIPMENT:

Service on mechanical & HVAC equipment requires special attention to personal safety.

Dangers working on mechanical & HVAC equipment include the following:

- Heat/flame: (inside furnaces & boilers, hot water tanks, vents)
- Electrical: (power to all units & components, breaker panels)
- Moving parts: (motors, fans, pulleys, belts)
- High pressure: (compressors, boilers)
- Chemical: (glycol, water treatment)
- Hot water: (boiler systems, hot water tanks, relief valves)

Major, specialized building maintenance will require the services of trained professional service providers*

**BUILDING MAINTENANCE REQUIRES ATTENTION TO ALL
STANDARD SAFETY PROCEDURES.**

**PLEASE ENSURE THAT ALL LOCAL FIRST NATIONS,
PROVINCIAL AND FEDERAL SAFETY PROCEDURES ARE
FOLLOWED.**

**FOR THE PURPOSE OF ALL INFORMATION PRESENTED IN THIS
TRAINING PRESENTATION, ALL FIRST NATIONS, PROVINICAL
AND FEDERAL SAFETY PROCEDURES & GUIDELINES SHOULD
BE FOLLOWED**

PROPER BUILDING PREVENTATIVE MAINTENANCE

Proper building Preventative Maintenance (PM) Programs begins with a complete Inspection of all buildings, facilities, equipment and components and then record all information & pictures in a documentation known as an Asset Condition Report.

A Preventive Maintenance program should be well defined, periodically reviewed and adjusted as necessary. To help ensure proper implementation, procedures should be written in sufficient detail for each piece of equipment in the program.¹

Why is preventive maintenance important?

The purpose of preventive maintenance is to try to maintain the equipment in optimum working condition and to help prevent any unplanned downtime due to breakdowns. Because components start to wear over time, replacing items prior to failure can cost you far less than the potential consequences of failure while in service. Some people see maintenance as an expense and it can often be one of the first departments to suffer from cuts during difficult times, however, this is very much false. Preventing problems from occurring will almost always be far less than the costs you will incur due to actual failures.²

It is important that all Assets are properly inventoried, logged and tagged. Asset numbers should be created for key assets such as HVAC.

Frequency and detail of all PM Activities are determined from manufactures recommendation, Industry Standards and information from Asset Inspections.

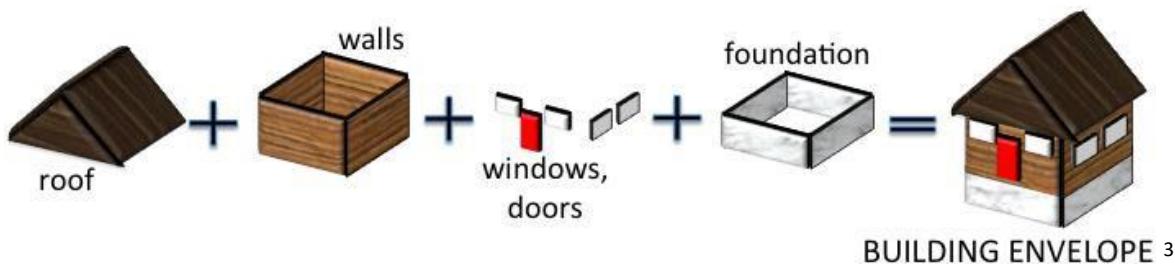
Log Sheets should be created and used for all Assets for all PM Activities and Inspections. Frequency and detail of all PM Activities are determined from manufactures recommendation, Industry Standards and information from Asset Inspections.

¹ <https://www.myodesie.com/wiki/index/returnEntry/id/3010>

² <https://www.buildings.com/article-details/articleid/6835/title/preventive-maintenance-checklist>

BUILDING ENVELOPE

The building envelope includes all the building components that separate the indoors from the outdoors. Building envelopes include the exterior walls, foundations, roof, windows and doors.



The performance of the building envelope is impacted by a number of sub-systems, such as heating, cooling and ventilating equipment, plumbing and electrical systems. The interaction of the sub-systems with the components of the building envelope, as well as certain activities of the occupants, can affect the performance of the building envelope.⁴

The building envelope should keep out:

- temperature extremes
- moisture, as vapour or liquid
- dust
- wind

Additionally, to maintain durability, the building envelope should not permit weather elements to be trapped inside the walls. This may cause wall components to deteriorate, and continue to decay. In the early stages, it can usually be remedied relatively inexpensively. As time progresses, costs increase exponentially.⁵

How do you know if there is a problem with a building envelope?

A problem with a Building Envelope likely exists if there is:

- No regular inspection and preventative maintenance program in place
- Mold or fungi formation
- Wood rot

3 "Building Envelope" by Augustine Musa

4 Homeowner Protection Office – Branch of BC Housing

5 Homeowner Protection Office – Branch of BC Housing

- Water flowing down the sides of the building instead of running off from the eaves and drainpipes
- Wind blowing through the walls
- Peeling paint
- Cracked or missing sealants (caulking) or if there are:
 - water stains on inside walls, ceilings or inside the foundation
 - Gaps that allow the weather to get through the walls
 - Pools of water on the decks
 - Windows that are wet on the inside.⁶

Maintenance and Inspections:

Maintenance of the Building Envelope begins with a visual inspection and then minor maintenance (if possible) or more extensive maintenance if deemed necessary.

Minor maintenance could include simple tasks such as clearing debris from roofs and roof drains and replacing missing caulking or removing and replacing damaged caulking from window sealings and around doors.

It is recommended that for major Building Envelope Components, such as roofs, that a professional and thorough inspection be conducted at least every three years. A professional roof inspection would include cut samples, moisture testing and infrared scans.

Early detection of potential major deficiencies and failures can be corrected at a much less expense and prevent further damage to other building components.

A typical Building Envelope Maintenance Plan Includes the Following:

- visual surveys of deterioration and openings in roofs
- annual repairs of detected deterioration
- infrared surveys of roofs every five years
- visual survey of wall-system components annually
- sealants in wall systems and window perimeters
- window glazing gaskets
- cracks and openings in wall-system components
- interior survey of openings in wall systems above the ceiling
- infrared survey of wall components every five years.⁷¹

⁶ Homeowner Protection Office – Branch of BC Housing

⁷ <https://www.facilitiesnet.com/energyefficiency/article/Building-Envelope-A-Maintenance-Checklist--11049>

Basic Maintenance During or After a Visual Inspection of the Building Envelope

As noted above, visual inspections and related minor maintenance can be completed on all Building Envelope components as outlined below:

Roofs:



NOTE: BEFORE ATTEMPTING ANY VISUAL INSPECTIONS OF ANY ROOF SURFACE, ENSURE THAT ALL SAFETY PRECAUTIONS FOR ROOF SAFETY AND LADDER USE ARE FOLLOWED.

Building Maintenance for roofs begin with visual inspections. Visual Inspections of Roof areas include the following:

1. Debris:

Any debris on a roof surface is a source of roof problems such as pooling or ponding and a potential for penetration of and premature wear of the roof membrane. Moss accumulation is also common on flat roofs. Debris on roofs can and should be easily cleared, **especially after the fall season and before snow accumulates on roof.**



This picture on the right indicates a potential for major roof debris every year. Tall trees or shrubs located adjacent to or close to buildings will always be a source of roof debris in the form of falling leaves and branches and will always require annual clean-up and maintenance.

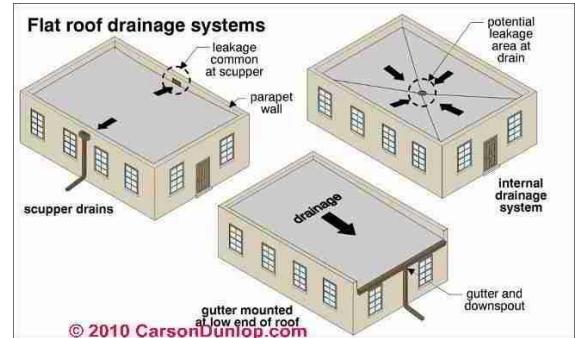


2. Pooling and Ponding:

Pooling and ponding on roofs is also often, but not always, the result of poor drainage caused by debris blocking, obstructing and clogging roof drains.

As above, pooling and ponding (standing water) on roofs could be caused by blocked drains and down spouts.

However, Pooling and Ponding could be a sign of major roof deficiencies such as negative slope (away from roof drains and/or scuppers) or lack of proper or sufficient drainage from roof. As well, any long-standing pooling or ponding on a roof will be a source of premature roof deterioration and a source of vegetation growth.



3. Buckling, Blistering or Cracking Membrane

Buckling, Blistering or Cracking is a sign of needed maintenance. Common deficiency in most BUR (Build up Roof) type of flat roofs. Indicates separation of roof felts and/or moisture entrapment. Buckled or Blistered areas often separate or crack over time.



As well, overtime, roof membrane seams may lose their “glue” and become detached from adjacent membrane or the flashing.

4. “Dark Areas”

Dark areas on flat roofs are an indication of extensive standing water and/or signs of mold and algae growth.



5. *Exterior Roof Components*

Many roof leaks and roof drainage problems are associated with faulty or missing exterior roof components. These components include flashing, scuppers, drains, and downspouts. Resealing around flashings, drains etc. should be performed after deficiencies noted during visual inspections.



Evidence of
flashing pulling
away from
building wall.

Flashing in good condition

Notice tight seams joining flashing sections.



6. Other Potential Sources of Roof Leaks and Deficiencies:

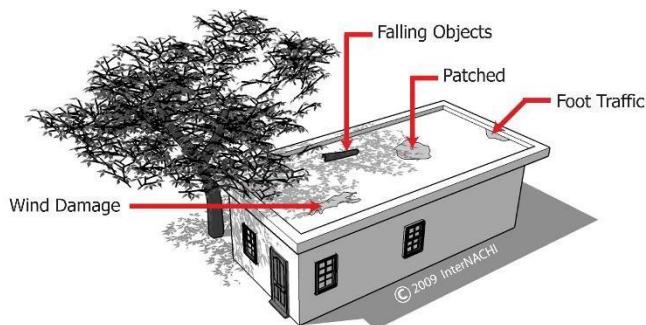
A. Penetration of HVAC/Mechanical components:

- Any penetration into or through the roof membrane is a potential source of water infiltration.
- The mastic (or sealant) around roof penetrations does deteriorate over time and becomes hard and brittle and subject to cracking.
- Resealing around vents, chimneys, skylights and HVAC piping, tubing or conduits should be completed when deficiencies are noted during visual inspections.

B. Foot Traffic:

- Most roof membranes are not designed for continual, heavy foot traffic.
- Premature erosion of granulation, indentations and potential for seam damage may occur as a result of unnecessary and constant foot traffic. Many commercial flat roofs have designated walkways that are raised from the roof membrane for necessary service and inspection foot traffic.

Flat Roof Defects



C. Forces of Nature

Excess snow, wind, rain and hail are also a source of roof damage. A visual and/or professional roof inspection should be completed after any major storm. Over time flat roofs lose their protective covering as they are exposed to sun, rain, and wind. This is how leaks start.

7. Alternate Methods of Roof Inspections:

Easy roof inspections can be completed from inside a facility. Look for cracking or peeling paint on ceilings or water stains on ceilings or ceiling tiles which indicate significant roof problems.



As well, if roof access is difficult, visual roof inspections can be completed by electronic methods such as camera on “selfie” sticks or drones with camera capabilities. However, a thorough and detailed visual inspection always requires the ability to closely examine the roof membrane, flashing and drainage system.

Remember:

Visual Roof Inspections DO NOT take the place of or replace Professional Detailed Roof Inspections and related reports from a certified and approved Roof Inspection Inspector or an Engineering Company.

The frequency of a professional roof inspection, including infrared scanning, moisture analysis and core sampling is dependent on the age of roof, location, weather conditions and results from visual inspections or past professional inspections.

8. Sample Roof Inspection Report/Checklist:



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TECHNICAL SERVICES
ADVISORY GROUP INC

Roof Inspection Checklist

SITE NAME:	ROOF SECTION IDENT:
ROOF TYPE:	Useful Life Expectancy:

Conditions:

- 1: Good Condition - Did not exceed useful life expectancy
- 2: Good Condition - Did exceed useful life expectancy
- 3: Fair Condition - Did not exceed useful life expectancy

- 4: Fair Condition - Did exceed useful life expectancy

1. General Roof Section Condition		Condition	
Problem descriptions:	Not Applicable	Normal Cond.	Abnormal Conditions
1.1 Infiltration			
1.2 Debris			
1.3 Water Accumulation			
1.4 Physical Damages			
1.6 Others			
General Comments:			

2. Surface Condition		Condition	
Problem descriptions:	Not Applicable	Normal Cond.	Abnormal Conditions
2.1 Undulations, wrinkles, blisters			
2.2 Wear, cracks, bare sections			
2.3 Insulating material displacement			
2.4 Sagging areas			
2.5 Visible joints			
2.6 Felt displacement or bunching			
2.7 Lifting of mechanical fasteners			
2.8 Surface wear and tear (access path)			
2.9 Alligatoring (multi-layers only)			
2.10 Moulding (specific areas)			
2.11 Others			
General Comments:			



FIRST NATIONS
TECHNICAL SERVICES
ADVISORY GROUP INC

Roof Inspection Checklist

SITE NAME:	ROOF SECTION IDENT:
ROOF TYPE:	Useful Life Expectancy:

Conditions:

- 1: Good Condition - Did not exceed useful life expectancy
2: Good Condition - Did exceed useful life expectancy
3: Fair Condition - Did not exceed useful life expectancy
4: Fair Condition - Did exceed useful life expectancy

3. Accessories and Projections Conditions			
Problem descriptions:	Not Applicable	Normal Cond.	Condition
3.1 Gravel stoppers			
3.2 Metallic items			
3.3 Drains (Specify number)	Number:		
3.4 Vents, lighting wells, caulking joints			
3.5 Flashings			
3.6 Plastic sleeves			
3.7 Gutters, Drainpipes (int & ext)			
3.8 Retaining walls, parapets, sloping roofs			
3.9 Ventilated areas			
3.10 Grease recovery containers			
3.11 Mechanical equipment base			
3.12 Waterproof putty container			
3.13 Others			
General Comments:			

4. Other observations:			
Problem descriptions:	Not Applicable	Normal Cond.	Condition
4.1 Ceilings			
4.2 Exterior walls			
4.3 Interior walls			
4.4 Others			
General Comments:			

Inspected By :	Date:
----------------	-------

9. Roof Maintenance Summary:

Whether the roof is flat or sloped, a regular visible maintenance inspection and minor repairs will reduce the likelihood of moisture penetration, costly repairs and as well, will extend the useful life of a roof.

A visible roof inspection should include, but not be limited to:

- Debris and damage
- Ponding or pooling
- Clearance of roof drains, scuppers & downspouts
- Damage to and necessary patching of flashings
- Visible shrinking, cracking or holes in mastic coverings of HVAC & Electrical roof penetrations.
- Pads under HVAC Equipment
- Visible interior paint peeling & staining on ceiling & walls.
- Visible water staining on exterior walls

EXTERIOR SHEATHING/CLADDING – EXTERIOR WALLS

The cladding of the exterior walls of most buildings may be composed of wood siding, vinyl siding, fiber cement board, concrete, masonry (brick) or stucco or a combination of any other above.

Cladding is the first line of defence in a wall assembly. It is critical for protection of the more sensitive components of the wall assembly and the interior of the building.

Proper maintenance of the cladding will reduce the likelihood of water penetration and preserve the appearance of the building. Wear and tear on cladding is expected since it is continually exposed to sun, rain, wind and temperature changes. In addition, cladding is subject to damage due to accidents, vandalism and excessive vegetation growth.⁸

How do you know if there is a problem with exterior walls?

A problem likely exists if there is:

- No regular inspection and preventative maintenance program in place
- Mold or fungi formation
- Wood rot
- Wind blowing through the walls
- Peeling paint
- Broken, Cracked or missing bricks, stucco or exterior panels
- Cracked or missing sealants (caulking) or if there are:
 - Water stains on inside walls, ceilings or inside the foundation
 - Gaps that allow the weather to get through the walls
 - Windows that are wet on the inside.⁹

Most of the newer buildings have exteriors planned to be as maintenance-free as possible. A newer building may feature concrete block or brick walls with breeze and fashion blocks in some walls. But some buildings may not be new, and the exterior may not be quite as maintenance-free. Even if new, the building's exterior will still need a periodic maintenance program to protect the materials. The specifics of the program will depend upon the materials used and their current condition. The biggest threats of the building's exterior are water, wind, sun, and snow.

⁸ Homeowner Protection Office – Branch of BC Housing

⁹ Homeowner Protection Office – Branch of BC Housing

A visual inspection of the exterior of a building should be done to look for the changing conditions of the exterior walls and covering. It is important to look for peeling paint, missing mortar or caulking between masonry joints, cracks that have appeared since the last observations, mildew or mold that is now growing on walls, bushes and shrubs that now touch the building's exterior. These are all clues that some maintenance action is needed.

The exterior walls of the building have to be kept clean and free of debris. Leaves and plant materials should be raked away from the walls so that any water that falls there will drain away, and not be retained where it might penetrate the walls and foundation. A semi-annual exterior cleaning is an important step in the maintenance process.

In exterior brick, concrete block, or any masonry walls, the basic concerns are cracking and water intrusion. Water can affect masonry in a variety of ways. It can affect the mortar, a special kind of binding cement applied at joints to hold the individual pieces of masonry together.

Over a period of time, water can erode the mortar, causing the original mortar mix to disintegrate. If there are cracks, there are more openings for water to enter. If there is a whitish film deposited on the face of the masonry, this is called efflorescence and is the result of dried mineral salts.



Water in the masonry picks up minerals, and when the water meets the outside air it evaporates, leaving a residue of mineral salts. If there is mortar falling out of the joints, it's time for a touch-up process called tuck-pointing. Fresh mortar has to be put into those open joints, using a small triangular shaped trowel. Over time, problems may plague the wainscot, the external masonry wall covering. The paint over the wainscot may peel or flake away due to moisture.

Wainscot can also crack due to settlement. Cracks must be filled to avoid water getting inside and causing further deterioration of the surface.



The joint between the masonry portion of the exterior and any other material such as wood or metal trim on doors and window frames should be carefully checked. Because the materials are dissimilar, they have different rates and characteristics of expansion and contraction. This movement can open the joint even if it has been caulked, and that can allow water to enter. A high grade of exterior caulk should be used to seal the joints.



Wood siding walls may be planks or boards installed either vertically or horizontally. Wood shingles or panels are made of exterior grade plywood or other composite materials such as hardboard or wafer-board. Wood siding products are all vulnerable to water. Two simple rules apply to maintaining wood exteriors:

1. The wood must be kept coated with a protective film, either paint or stain with a wood preservative.
2. *All joints and openings must be caulked to prevent water intrusion.*



When the protective coating starts to wear, it loses its ability to shed water. The underlying wood becomes susceptible to water intrusion, then warping and rotting. Therefore, in the periodic stroll around a building, look for peeling or flaking paint, or stains that have worn so thin that the wood grain is exposed and raised. Also look for open joints, however small, where water can penetrate; open joints pose problems even if the paint or stain coating itself is in prime condition.

Action should be taken before wood rot sets in because if that occurs, the only course may be to tear off the rotted section and install new materials, which is always more expensive.

Typically, the maximum time interval for repainting or re-staining and applying waterproofing is seven to ten years for wood plank siding, or wood shingles; though it is

better to plan on a five to a seven-year cycle. For other wood materials, it is much less. Exterior plywood must be checked each year and may need more frequent treatment. Particle board certainly will need touch-up every year to avoid warping and disintegration. Remember that exposed edges of any wood siding material, plank, shingle or panel, are the points where water is most likely to penetrate and cause problems. Those edges should be well sealed with paint and caulk.¹⁰

Exterior sheathing materials, such as brick, are also subjected to ground settling and or "heaves" caused by frost and cold weather which may cause premature cracking of the brick and joint mortar failure.

Building cladding deficiencies and failures may go unnoticed for years and eventually cause extensive damage to both the exterior and interior of buildings and as well, become a health and safety hazard to building occupants.

For example, in British Columbia, over 900 buildings constructed in the 1980's and 1990's were severely impacted by building envelope failure in what is called the "Leaky Condo Crisis".

"By 2003, the B.C. Homeowner Protection Office had identified about 65,000 leaky condos across the province.

The Canada Mortgage and Housing Corporation defines leaky condos as a "catastrophic failure" of building envelopes, which lets water into the building frame and leads to rot, rust, decay and mold.



...It is estimated the problem eventually cost the provincial economy between \$3 billion and \$5 billion. The crisis was caused by a combination of poor design and shoddy construction during a building boom. Many homeowners, suddenly facing thousands of dollars in repairs, went bankrupt. The crisis is said to have cost the B.C. economy billions of dollars."¹¹

¹⁰ School Maintenance Program, Winslow Davis, Author

¹¹ CBC News - Posted: Apr 07, 2018

Building Sheathing/Cladding – Exterior Wall Summary:

As with regular visible maintenance on roofs, a regular visible maintenance inspection and minor repairs on Exterior walls will reduce the likelihood of moisture and other weather related wall penetrations, very costly exterior and especially interior repairs and as well, will extend the useful life of the covering of the exterior walls.

Wood siding and trim should be properly cleaned every 2 years and repainted every 7-10 years. Exposure to the weather and sun may require a more frequent interval.

Vinyl and stucco siding should be properly cleaned every 2 years.

Masonry/Brick Cleaning should be conducted every 5 years.

Masonry/Brick Repairs, such as re-caulking and repointing on mortar joints, corners, cracks, flashings and joints between the exterior cladding and window and door frames should be conducted when deficiencies are noticed.

Never use a pressure washer to clean the exterior cladding. The excessive water pressure can cause damage to the surface of the cladding and force water into the wall cavity behind.¹²

Checklist of Common Cladding Maintenance Items

Cladding Type	Review/Maintenance Item	Frequency
All	Maintenance contractor or trade contractor to review condition of cladding, finishes and sealant.	Annually
All	Remove any vegetation, such as trees or shrubs, that encroaches on the cladding.	Annually
	Review metal flashings for corrosion and proper slope away from the building.	2-3 years
	Review fasteners and metal connectors that attach the cladding to the walls.	5 years
	Touch up paint to metal flashings.	7 years
	Replace exterior sealant.	10 years
Wood Siding	Clean wood siding with non-pressurized soapy water.	3 years
	Review wood siding for warping, damage, loose panels and discoloration.	3 years
	Touch up painting or staining of wood siding.	7 years
Vinyl Siding	Clean vinyl surfaces with non-pressurized soapy water.	2 years
	Review vinyl siding for discoloration, dislodged sections and damage.	2 years
Stucco	Clean stucco surfaces with non-pressurized water or stucco cleaning solution.	2 years
	Review stucco for cracks, staining, vegetation growth, corrosion of stucco stops and control joints, and delamination of finish coat.	2 years
	Recoat acrylic stucco finish.	7-10 years
Masonry	Clean surfaces with water or cleaning solutions for masonry. Do not use pressurized water as it could damage the mortar joints.	5 years
	Review masonry for cracking, spalling and loose units.	5 years
	Reseal exterior face of masonry.	6 years
Fibre Cement Board	Clean and repoint mortar.	15 years
	Review for cracking, efflorescence and damage.	2 years
	Clean surfaces with non-pressurized soapy water or soft material.	5 years
	Recoat fibre cement board.	

¹² Checklist of Common Cladding Maintenance Items - [Homeowner Protection Office](#) - Branch of BC Housing

EXTERIOR WINDOWS AND DOORS:

Exterior windows and doors are a vital component of the Building Envelope. Often when there is noticeable water infiltration on window glass, sills or adjacent walls, noticeable condensation, heat loss, wind or cold air “drafts” from the outside, the method of entry is from defective, old, or energy non-efficient windows or doors.

As well, the windows or doors themselves may still be in good condition, however, lack of proper maintenance, such as repainting, resealing and re-caulking have not



been completed in a timely manner.



Preventative Building Maintenance on window and doors starts with the same principals as with all Building Envelope Maintenance; a good visual inspection from both the exterior and interior.

As noted on the previous page, look for noticeable water infiltration on window glass, sills or adjacent walls, noticeable condensation, heat loss, wind or cold air “drafts” from the outside.

As well, faded, cracked and peeled exterior and interior painting, and caulking are a clear indication of window and/or door sealing failure.

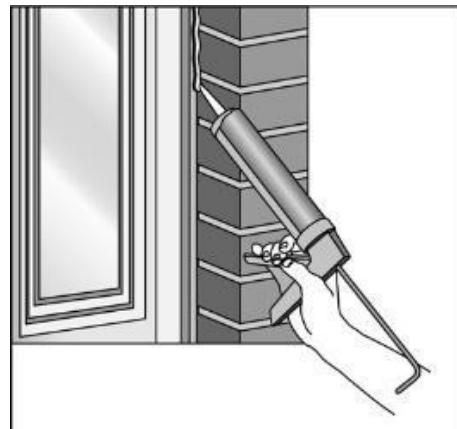


Preventative Building Maintenance on Window and Doors could be as simple as repainting or re-caulking where the windows meet the frame, wall or exterior siding. On doors, new door sweeps, thresholds and door seals could be installed.

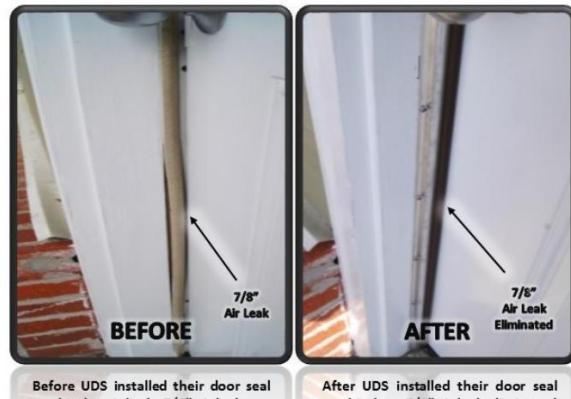
However, original wood or aluminum windows with noticeable condensation between "sealed" window panes or glass cracks will probably require replacement with more energy efficient products.

Commercial Entrance Doors can properly be maintained by replacement of thresholds, astragals, door sweeps, weather stripping and door seals. Commercial Doors often require re-caulking where the door meets the exterior siding.

As well, regular lubrication of hinges and all moving parts will maintain the easy of door openings and closing. Be sure not to use commercial lubricants inside of pin tumbler locks. Pin tumbler locks should only be lubricated with powder graphite.



AIR LEAK LEFT SIDE OF THE DOOR



Before UDS installed their door seal on this door it had a 7/8" air leak

After UDS installed their door seal on this door, 7/8" air leak eliminated

HDCDS - 300 Commercial Door Seal



CDS - 300 Commercial Nylon Door Sweep

AIR LEAK BOTTOM OF THE DOOR



Before UDS installed their door seal on this door it had a 5/8" air leak

After UDS installed their door seal on this door, 5/8" air leak eliminated

Door Seal Photos Courtesy of ULTIMATE DOOR SEALS LLC,

Preventative Building Maintenance on all doors, especially commercial doors, includes the maintenance of door hardware including; thresholds, locking devices, hinges, hydraulic closures, panic hardware and Handicap/Accessibility Access controls.



Panic Hardware and Handicap/Accessibility Access are especially important to properly and regularly maintain as both are Building Code issues and involve the Safety of Building Occupants.

Regular maintenance on doors is mainly lubrication and adjustment when required.



Door parts will wear out overtime and require replacement. Heavy use and especially "abuse" will cause premature wear. Door Hinges, despite regular lubrication, will eventually wear, especially the pin inside. If the door seems loose or "wobbly" when opening and closing or if a door binds when opening and closing, the door is out of alignment and there is a good possibility of worn hinges that have to be replaced.



The screws on the hinges often become loose either on the door frame and/or door and often have to be retightened or replaced.



As well, many commercial doors operate on top and bottom pins or pivots. These pins or pivots will wear over time and perhaps even break, causing a need to have the pins or pivots

replaced. These top and bottom pins and pivots can be adjusted in order to prevent the door from dragging on the floor or perhaps binding on the edges.

Hydraulic door closures need very little maintenance except for occasional adjustment. If the door does not open all the way or “bangs” when closing, the cause could be that the alignment needs to be reset by proper adjustment of the movable arm that connects the door frame to the closure or a screw on the hydraulic cylinder. Also, if a door “bangs” when closing, it could be a sign that the closure needs to be replaced. Once a hydraulic closure begins to leak oil, replacement is required.

Most hydraulic door closures come with instructions on how to maintain and adjust.



Sample Window and Door Inspection Report/Checklists:



Windows & Doors Inspection Checklist

SITE NAME: _____ DATE: _____

General Condition of Windows:		Condition
Problem descriptions:	Check if Applicable	Location of Window
Cracked or Broken Window Panes/Glass		
Moisture Inside Windows		
Loose, Cracked or Missing Glazing Putty		
Caulking Between Windows & Cladding Cracked		
Weatherstripping/Seal Around Windows Cracked or Missing		
Wood Window Frames Require Painting		
Others:		
General Comments:		

General Condition of Doors:		Condition
Problem descriptions:	Check if Applicable	Location of Door(s):
Door Binds When Opening & Closing		
Weatherstripping Around Door Broken or Missing		
Threshold Missing, Worn or Loose		
Door Hinges Worn, Loose or Needs Replacement		
Bottom & Top Door Pivots Worn or Loose		
Hydraulic Closure Needs Adjustment or Leaking Oil		
Cracked or Broken Glass		
Door Locks Require Lubrication or Repair		
Door Handles or Pulls Loose		
Entrance To & Entry Door Handicap Accessible		
Entrance Doors Meet Handicap Accessible Width (32")		
Handicap Access Door Openers Function Properly		
Others:		
General Comments:		

Inspected By : _____ Date: _____

CONDITION RATING:

Conditions:

- 1: Excellent/New Condition - Does Not Require Any Further Maintenance
- 2: Good Condition - Requires only Lubrication/Cleaning
- 3: Fair Condition - Requires Further Maintenance as Described
- 4: Poor Condition - Requires Replacement

FOUNDATIONS & BASEMENT WALLS:

The condition of the foundation of any building or facility will have an impact on other building/facility components including flooring, exterior and interior walls, windows, doors and indoor air quality. Below is a list of some interior and exterior symptoms of foundation failure.¹³¹

Interior Symptoms:



Uneven or sloping floor

As a foundation settles, so do the floor joists and the finished flooring above.



Inward bowing walls

Water-saturated soil can sometimes exert enough pressure to cause foundation walls to bow, bulge or tilt.



Cracks in floor

When concrete slabs often settle unevenly, large cracks are likely to form.



Sagging floors over a crawl space

Whether it's poor footings or inadequate posts and beams, we can quickly jack your floors back to level.



Cracks in interior wall

Interior wall cracks typically appear where walls are weakest: near doors and windows.



Hard to open windows & doors

When a floor sinks, openings become out of square, causing windows and doors to jam.

Exterior Symptoms:



Tilting chimneys

A tilting chimney can be stabilized and returned to its original position without demolition.



Street creep

When street materials expand and push your driveway against your garage foundation, we can relieve the pressure!



Cracks in exterior wall

As a foundation is returned to its original level state, cracks will close and be ready for patching.

In addition to the above, the most common indications of foundation failures include:

- Noticeable vertical cracks in foundations
- Water penetration & Seepage on walls combine with noticeable white staining or efflorescence
- Water pooling or noticeable water staining Basement floors.
- Uneven Basement or Other Floors

¹³ Ridgeback Basement Systems of Nova Scotia, New Brunswick & Prince Edward Island;
<https://www.ridgebackbasement.ca/foundation-repair/foundation-problems.html>

- Outside surfaces around surrounding walls have a negative slope towards the building.
- Noticeable gaps or space between interior and exterior walls and adjacent Windows or Doors become wider.



Repairs to foundation failure can be completed depending on the extent of the damage.

For minor cracks in concrete walls, an epoxy mix can be injected into the cracks. If this injection method is done proper, the epoxy will seep through the cracks though the wall and penetrate the exterior. This method, again if done properly will provide a “leak proof” repair to minor concrete cracks on foundation walls. A “Tar” coating on the inside of a wall does penetrate to the exterior and does not entirely solve a water infiltration problem on basement foundation walls.





Unfortunately, any major damage can only be repaired by extensive exterior trenching, applying a membrane coat of either tar, a polyurethane product or, possibly, a dimpled elastomeric or plastic membrane.

Foundations & Basement Walls: Crawl Spaces:

The foundation of many facilities encompass a crawl space under the main floor. Crawlspaces could present a number of challenges for the integrity of the facility including; water/moisture infiltration, rodent infiltration, IAQ problems such as mold and heating & ventilation problems. Moisture in soil or negative grading could create a water/moisture problem in crawl spaces.





NOTE:

Before attempting access to any crawl space ensure that all safety precautions are followed and proper PPE is being used including: safety glasses, gloves, hardhat, a respirator and a disposable one-piece coverall hazmat suite should be considered.

Moisture and IAQ issues such as mold are the main issues associated with crawlspaces. Long standing water will create mold, associated bacteria, breathing irritation, and other IAQ problems.

Heating vents, electrical, plumbing and HVAC components all run through a crawl space to their proper position through the floor.



In order to mitigate potential, IAQ problems, problems with moisture and standing water and freezing plumbing and HVAC components, heaters should be installed in strategic locations in crawl spaces. Weeping tile could be installed inside footings.

As well, sump pumps should be installed in areas of water accumulation and tested at least twice a year. Weeping tile strategically located could drain into sump pits. All interior concrete walls should be properly sealed with tar, liquid asphalt or other sealing materials.

To address the water entering the crawlspace from the exterior due to negative grading, and also water from the crawlspace area, install weeping tile around interior side of footings c/w weeping tile laterals throughout the crawl space draining into sump pits c/w discharge to exterior.



A requirement of the NBC and to eliminate moisture creating unhealthy mold and related condition, remove all debris and provide a 6mil poly moisture barrier and a fire retardant (tarp) type of ground cover.



Summary:

Although some settling of any foundation may be considered “normal” in cold climates, deficiencies in Foundations, Basement Walls or Crawlspaces that require attention can be recognized through visual inspections of the following:

- Exterior cracks in foundation material (concrete, bricks etc.)
- Exterior cracks on building cladding especially around doors & windows.
- Interior wall cracks especially around doors & windows.
- Interior wall cracks on basement concrete walls.
- Water seepage on floors of basements
- Separation of door and window trims from walls.
- Binding of doors and windows.
- Sagging, sloping or uneven floors
- High Humidity, musty or mold smell coming from crawlspace opening
- Moisture on floor or walls of crawlspaces

Minor interior cracks can be mitigated by urethane/epoxy injection. Major foundation, basement wall, or crawlspace wall repairs require excavation, repair of any cracks by recoating of wall with an asphalt/tar or a proper membrane cover and then reinstalling weeping tile and proper drainage over a layer of course crushed gravel or rock and then covering with a layer of course crushed gravel or rock.

Moisture in crawl spaces can be corrected by installing sump pits and sump pumps and proper heating and ventilation systems and as well, repairs to crawlspace walls. Additional weeping tile, simple Exhaust Fans on timers moving crawlspace interior air to the outside will also provide some beneficial results.



DRAINAGE:

Fully functioning and properly sized drainage that is in good working order, not restricted by debris, tree or shrub roots or crushed walls and installed with proper slope will prevent most water infiltration problems

Water on basement floors, ponding and pooling around buildings or “soft” spots adjacent to buildings or located along drainage pipes could be the result of blocked or poor drainage. Toilets and sinks that drain very slowly or continually back up are also a sign of sanitary or sewage drainage problems.



The drainage system of buildings also include drainage from the roof in the form of downspouts. Roof drainage often gets clogged with leaves and debris and require semi-annual inspection and cleaning. Some downspouts are directed into the drainage system inside a facility. Other downspouts are directed along the side of a building and then directed away from the building. The drainage from exterior downspouts should be extended and directed at least 4 feet from a building.



Inspection video cameras are easily inserted into drainage lines to determine the cause and area of blockage. Repairs can then be made based on the information from a video camera inspection.



Site Grounds:

Clean, well-kept grounds, free from discarded matter, litter and scrap will provide a safe environment for all those outside a facility.



As well, grounds with landscaping that has regular cut grass, trimmed bushes and trees and weed free manicured shrub beds will additionally enhance the look of the facility.

Site Grounds also include walkways, sidewalks, driveways and roads and parking lots.

Walkways, sidewalks, driveways, roads and parking lots that are free from trip hazards, uneven surfaces, potholes, missing and loose concrete or gravel are vital to the health and safety of all those entering or exiting the grounds and facility.

Walkways and Sidewalks:

All walkways and sidewalks need to be free from any actual or potential trip hazard. Trip hazards include, uneven surfaces, loose or missing concrete, asphalt or gravel.

Any tripping hazards should be eliminated through repair, ramping or clearing. Repairs must also be done if the condition of the material deteriorates and creates an eyesore.

Driveways and parking lots are typically built of either asphalt, concrete or gravel. All require some degree of maintenance. Gravel driveways often develop ruts, and if severe enough, regrading may be needed in addition to more gravel. Concrete is a durable material, but it may start to crack as the ground under the driveway shifts slightly.



Asphalt driveways may experience sinking, or the surface can crack due to settlement and water, but asphalt can be patched. When severely deteriorated, an asphalt driveway can have a new topcoat added, provided that the additional coating does not create a problem to the school building. The driveway elevation should be below the school building floor so that rain will drain away from the school building, not into it. An elevation mismatch can create a water problem, so the old asphalt driveway may have to be removed, and a new one laid, if the potential for that problem arises.



Particular attention should be paid to the direction of the water flow in heavy rain. If either a sidewalk, walkway, courtyard, driveway, or parking lot is tilted toward the school building, forcing water toward it, then a flood proofing technique is in order before water ends up in the school building. Flood proofing techniques are used to reduce flood damage to the buildings. It includes, among others, tearing out the existing sidewalk, walkway, courtyard, driveway, or parking lot and reinstalling it or constructing barriers to stop flood-water from entering the school building.

Parking Lots:

Parking lots, like driveways are typically constructed of asphalt or gravel and will suffer the same deterioration problems such as cracking, alligatoring, rutting and other defects.

Proper drainage is also a major defect of parking lots. Parking lots are often constructed with little or no drainage or slope and water often ponds and pools in parking lots. Drainage that is in parking lots, are often blocked with debris or have other deficiencies that prevent proper drainage.



Parking lot and driveway curbing is often constructed of poured concrete or precast parking curbs

All parking curbs suffer damage especially during the winter months during snow removal.



Basic Preventative Maintenance Tasks for Building Grounds:

- INSPECT – Inspect and remove all grounds from debris, garbage and litter.
- CLEAR – Clear any trip hazards that can be removed
- REPAIR – Arrange for repair or replacement of major trip hazards that affect building entry, including sidewalks and steps.
- PLAN – Plan for major capital projects to replace uneven and broken walkways, driveway and parking lot deficiencies.

Sample Building - Ground Checklist:

Building - Grounds Checklist				
Date:	Facility:			
Name:	Community:			
<small>Confirm specific item with the description. Leave section blank if the item does not exist.</small>		<small>Choose one</small>		<small>If unsatisfactory, describe problem(s)</small>
		Satisfactory	Unsatisfactory	<small>Where is the unsatisfactory component located in the school building?</small>
Main Entrance				
Sidewalks and walkways				
Parking lot and driveway				
Retaining walls				
Fencing				
Garbage Bins / Recycling				
Playgrounds				
Snow removal				
Yard Maintenance				
Storage Sheds				
Drainage / Grading				
Signage				
Bicycle Rack				
Bleachers / Benches				
Sports Equipment				
Rodents Control				
Stairs – Railing/Ramp				
Graffiti				
Flagpoles (Anchors)				
Other:				
General Remarks:				

SITE SERVICES

Site Services include all utilities servicing the site and facility including; water, sewage-septic system, natural gas and power-electricity services.

Many sites also have auxiliary services including fuel and heating oil storage and backup power generators.

Access to all site services should always be kept free and clear.

As well, some form of protection and/or fencing should be supplied to all site services where potential damage from vehicles may occur, and especially where entry to the site service compound may cause serious injury or death.



Natural Gas – Propane – Fuel Oil

Danger and Warning signs for all services including underground and overhead services should be clearly visible. For Natural Gas, Propane or Fuel Oil, these warning signs should include wording such as “No Smoking” or “Open Flames”



Preventative Maintenance for Natural Gas or Propane supply systems should only be visible and “sniff” or “smell” tests.

Building Maintenance and Preventative Maintenance for Natural Gas or Propane Systems includes:

- Check for odors similar to a “rotten egg” smell around connections and fittings
- Check for “Hissing” or “Whistling” Sound from connections
- Check proper operation of all Carbon Monoxide detectors.
- Check if building occupants are feeling dizzy or light headed



Emergency Shut-Off Valves for all site services should be clearly marked and easily visible. Local personnel should be trained in operating shut-off procedures.

Water:

Clean potable water is essential in any facility. Building Maintenance and Preventative Maintenance to ensure uninterrupted clean water includes checking the integrity of all valves, fittings, connections and checking for, corrosion, rust or leaks. A water line can be checked for visible leaking or “soft spots” along the ground of the water line.

Discoloration and differences in odor or taste of the water can be an indication of problems and deficiencies in the water supply line.

Septic & Sewage:

Building Maintenance and Preventative Maintenance for Septic or Sewage includes:

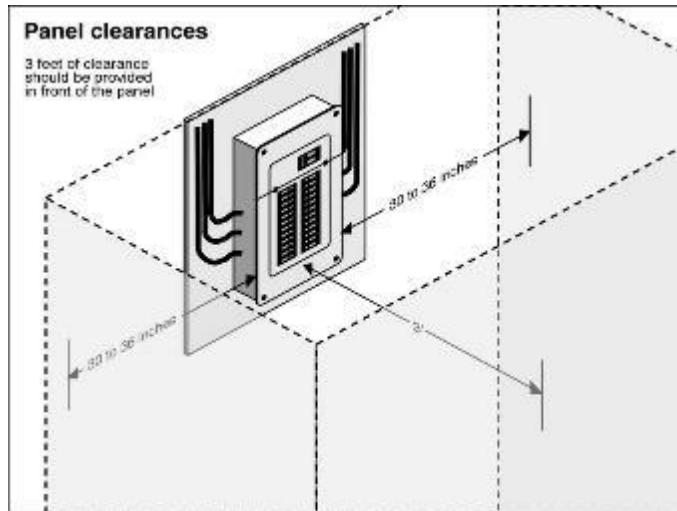
- Check for slow draining toilets or urinals
- Toilets and drains are starting to back up
- Check condition of associated sump pumps
- Check for soft spots and odor on ground near septic tank or sewage field.

Electricity & Power:

Electrical power to a facility is provided by overhead lines or services that are underground.

The electrical services then run through a metering system into a main electrical panel box then onto subsidiary distribution panels or breaker panels.

It is important that all distribution panels be kept free and clear from any storage items. The minimum clearance in front of panels is 36". All panels should be locked.



As well, any overhead lines leading into a facility need to be kept free and clear from tree branches. Often utility companies will provide this service.



INTERIOR FINISHES

Interior finishes include floors, doors, walls, baseboards, ceilings, washroom partitions and other fixed interior fixtures.

Flooring:

Flooring in commercial or institution facilities is often Vinyl Composite Tile (VCT). VCT, if properly maintained is tough, durable and long lasting.

Unfortunately, many VCT floors are either not installed properly or often not maintained properly.

VCT floors that are not installed properly will begin to have adhesion problems and lift and move. Often the cause is improper installation, type of or minimal amount of adhesives applied.

However, the best laid VCT flooring will wear quickly, especially in high traffic areas or around entrances, if not maintained properly.

Proper maintenance of VCT or any flooring begins with regular and thorough cleaning and washing. Grit and grime will act as sandpaper on flooring surfaces and the finish will dull and wear very quickly.

As well, the proper and regular application of floor wax is vital to maintaining a VCT (or any other) floor covering. Although there is some debate regarding the frequency and number of coats that should be applied, the traffic pattern, location and weather conditions will



determine the best process to keep and maintain a VCT floor.

Daily/Regular Maintenance:

Daily and Regular Maintenance of VCT Floor extends to all types of flooring besides VCT. This includes terrazo tile, polished concrete or epoxy coated floors.

- Sweep, dust mop or vacuum the floor daily to remove dust, dirt, grit and debris that can damage the floor and become ground into the surface.
- Spot mop as needed. Any spills should be cleaned up immediately.
- Damp mopping of the floor should be performed on a regular or daily basis, depending upon traffic and soil levels in the area. Use a properly diluted neutral detergent solution, such as Armstrong S-485 Commercial Floor Cleaner.

Periodic Maintenance:

- When needed, machine scrub the floor with a properly diluted neutral detergent solution (such as Armstrong S-485 Commercial Floor Cleaner) and the appropriate scrubbing pad (3M red or equal for light scrub, 3M blue or equal for a deep scrub) or equivalent brush.
- Thoroughly rinse the entire floor with fresh, clean water. Remove rinse water and allow the floor to dry completely.
- If there is sufficient polish (3 to 5 coats) remaining on the floor, buff, spray buff or burnish to restore gloss.
- If needed, additional coats of floor polish may be applied at this time.¹⁴

In older facilities, VAT (Vinyl Asbestos Tiles) tiles may still be in place. VAT tiles were quite common in the 1960's and 1970's due to their durability.



¹⁴ Armstrong Flooring - <https://www.armstrongflooring.com/pdbupimages-flr/197969.pdf>

Despite VAT tiles being non-friable (cannot be easily crumbled by hand), as the name suggests, VAT tiles do continue asbestos and must be maintained, repaired or replaced with proper and safe procedures.

"Damage and deterioration will increase the friability of asbestos-containing materials. Water damage, continual vibration, aging, and physical impact such as drilling, grinding, buffing, cutting, sawing, or striking can break the materials down making fiber release more likely."¹⁵

One method to eliminate any potential asbestos hazard is to cover and seal asbestos containing material. This method is called encapsulation. Encapsulation is to cover the material, such a VAT tiles with a wrapping or coating such as epoxy. Often, new VCT tiles are just placed over top of old, encapsulated VAT tiles. This method eliminates the need for professional Asbestos Abatement.

Doors & Windows:

Depending on traffic levels, interior doors in commercial or institutional facilities are often subjected to a lot of wear and the occasional abuse.

Door closures, hinges, push bars, handles and locking mechanisms require regular preventative maintenance and often repair.

Handicap Accessible Doors requires special and frequent attention in order to maintain proper opening and closing.

The finish on all doors, especially wood doors, are often subjected to high wear.

Preventative Maintenance for all doors include:

- Daily Inspection for proper operation and missing parts
- Daily cleaning or wiping down door surfaces with a mild cleaning solution
- Daily cleaning of glass if installed on door.
- As required, lubrication of hinges and locking devices
- As required, repainting or refinishing of worn door surfaces.
- As required, replacing worn parts such as hinges, hydraulic closures and locking devices.
- For Emergency Panic hardware (push bars) daily testing for proper operation.

¹⁵ University of Oregon - <https://ehs.oregonstate.edu/asb-when>

Windows, if constructed to open, should be checked regularly for proper operation as well as missing or cracked sealing and condition of glass.

Walls:

Walls should be visibly inspected on a regular basis to look for any damage, stains from seeping water from hidden piping, graffiti or other defacement and general dirt or other marks and stains. Repairing and repainting may be necessary to cover badly stained, damaged or defaced walls.

The cleaning of walls should also be on a periodic cleaning schedule using janitorial equipment and cleaning products depending on the type of wall.

Also, corners if often and badly damaged, may need some corner protections permanently installed.

There is no real preventative maintenance for walls except for janitorial services.

Ceilings:



Ceilings in commercial or institutional facilities usually consists of drop down suspended tiles, fixed tiles, acoustic, open or drywall type of ceilings.

As with floors, ceilings should be visibly inspected on a regular bases to look for damage, stains from water leaks, or missing or damaged parts. Drop down or suspended ceilings often have missing or broken tiles, or detached hangers.

One aspect that is often overlooked in ceiling maintenance is mid or high level cleaning. As described in the Janitorial Services section, high dusting or cleaning is the dusting and/or cleaning of areas that are normally difficult to clean because of their height such as vents, piping, and ceiling. High dusting is often referred to areas above 16' high. Special

equipment and training are important when performing high dusting and cleaning services.



Mid and High-Level Dusting and Cleaning is especially important in facilities with an open beam or exposed beam ceiling. Dust, dirt and debris often pile on top of beams, rafter and on top of hanging light fixtures.

Washroom Partitions:

The finish on Washroom partitions are typically powdered coated which provides a durable, cleanable surface provided some form of periodic cleaning and maintenance is performed.

Along with routine cleaning, cleaning with a sponge or soft cloth using a mild cleaning product, and sanitizing around the handles and locks, the following preventative maintenance procedures should be done on a regular basis:

- Tighten any screws that have become loose due to vibrational forces or attempted vandalism.
- Check the top door pin to be sure it is flush with the top of the hinge. Be sure the surfaces are dry after being cleaned and rinsed with clear water (when required).
- Partitions exposed to severe humidity should be washed and dried frequently. Use of cleaning agents containing abrasives such as household cleaning powder, steel wool, and harsh detergents or acids ARE NOT RECOMMENDED.
- Where additional gloss and protection is desirable, light applications of commercial liquid or paste waxes are highly recommended.
- If your partitions have a continuous hinge, regular application of an LPS II or an industrial type, non-drying lubricant is recommended.¹⁶

¹⁶ Hadrian Manufacturing - https://www.hadrian-inc.com/getattachment/Tech-Data/Toilet-Partitions/Powder-Coated/Maintenance_ANTI-GRAFFITI.pdf.aspx

ELECTRICAL SYSTEMS AND FUNCTIONS

The electrical system in a facility consists of all electrical power coming into a facility through a main power breaker system, then through a distribution system and ending at electrical devices such as lights, plugs and switches.



Extreme high voltage electrical power is dangerous and will cause serious injury or death if all essential precautions are not followed.



Only qualified personnel should be accessing, maintaining and servicing high voltage electrical equipment.



In working on or servicing any electrical fixture, device or component, ensure that all safety precautions are followed, the power to the fixture, device or component is turned off and then checked again to confirm that the power is turned off and proper lockout/tagout procedures are followed.

Interior Distribution System

Panel Boards

Distribution panel boards typically use three phase, 4 wire input. Both 277/480 Volt and 120/208 Volt panels are used. These panels typically contain a solid neutral, identified by the white jacketing or white phase tape, separate ground bus identified by the green jacketed wire or bare copper, the three hot phases identified as red, black, and blue by either their jacket or phase tape, and circuit breaker/branch circuit types equipped with bolt-on circuit breakers.

Panels function as the smallest unit of the Power Distribution System. Power feeds are connected to the panels via



a main circuit breaker or main lugs and are then distributed to smaller load segments via properly sized branch circuit breakers installed within the panel. The make of the breakers must match the make of the panel.

Panels for emergency use will usually have the letter "E" preceding any labelling and "UPS" preceding any labelling numbers where panels are fed through an Uninterruptible Power Supply unit that provides conditioned and back-up power to the loads served.



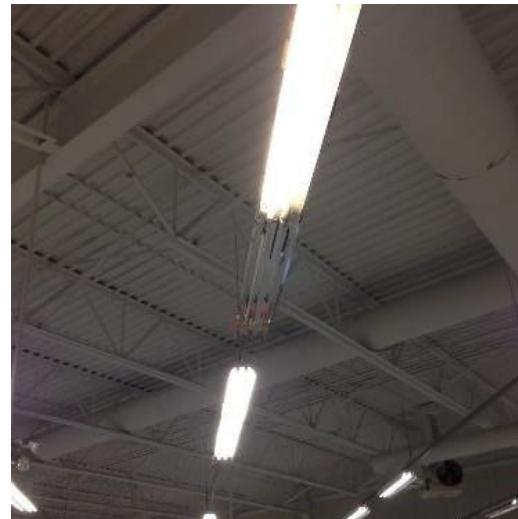
Lighting

Lighting within buildings is typically provided by fluorescent luminaires using either T8, or T12 lamps, or LED lighting fixtures.

T12 and T8 Fixtures do not provide the energy and maintenance savings as LED fixtures, hence new construction and lighting retrofits mainly source LED Lighting.

LED lighting fixtures are most common in new facilities and lighting retrofits and upgrades.

T12 Fixtures and replacement tubes are being phased out of production.



Due to performance limitations of fluorescent lighting in colder temperatures it is usually not used where temperatures are much below room temperature (15-20C).

Exterior lighting, for stairways, landings, arenas, and parking lots will usually use the high-

pressure sodium or metal halide, however, LED lighting for exterior lighting is widely being used due to energy efficiency, long life and low maintenance.

Smaller facilities may even use traditional incandescent lighting. LED replacement bulbs are now common and standard for most applications.

Surface or pendant mounted high-pressure sodium lighting will be used in industrial atmospheres for interior locations as well as LED in newer or upgraded buildings.

Industrial fluorescent lighting is typically provided in the Electrical and Mechanical rooms. General purpose lighting is usually 120Volt branch circuits. Lighting levels will be designed to meet or exceed Illuminating Engineering Society (IES) recommended levels.

Colour Temperature:

Lighting fixture types will be specified as appropriate for the areas of installation that are classified as a hazardous, corrosive, or wet locations.

Emergency lighting consists primarily of ballast-channel-mounted, emergency lighting units (back-up ballasts) installed in fluorescent luminaries. In unheated areas, the incandescent or LED fixtures that provide normal lighting are connected to an uninterruptible power supply (UPS) that provides approximately 90 minutes of back up lighting. Emergency lighting within industrial buildings, and plants is provided through wall mounted halogen lighting fixtures, which are equipped with back up ballasts, and a push button that facilitates periodic testing of the emergency lighting lamps. Pressing the push button illuminates the back-up fluorescent lamps to verify functionality.



Exit signs within buildings or plants are typically low energy consumption. Exit Lighting signs/fixtures are battery-powered, rechargeable, Light Emitting Diode (LED) devices. A sealed, maintenance free, nickel cadmium battery, contained in the fixture, delivers emergency DC power facilitate illumination in the event of a power outage. Conveniently located test switch and status indicator provide visual and manual means of monitoring system operation. Exit signs are also self-luminous. Self-illumination is provided by tritium gas encapsulated within the sign, or LEDs.



Building exterior lighting consists of high-pressure sodium, metal halides, or LED fixtures controlled through time clocks and lighting contactors with hand-off-automatic selector switches. Typically wall pack fixtures provide lighting for the perimeter of the building.



LED exterior fixtures, either wall mounted, or pole mounted are common for new construction and lighting upgrades and retrofits.

Receptacles:

Building receptacles typically are 120/240V. Duplex receptacles rooms, halls, offices and general areas will generally be 120V receptacles ranging from 15-20 amps.

Receptacles for 240V are usually for space heaters, dryers, and ranges. These receptacles will range from 30-50amps.

All outside receptacles should be GFCI rated with weather protecting covers. Receptacles located in wet locations, washrooms, or within 1.5m of a sink also need to be GFCI rated.

All receptacles should be labelled identifying the circuit and panel.

In new construction and energy retrofits, exterior parking lots are being retrofitted to an IPLC outlets. The Intelligent Parking Lot Control is a smart power receptacle that can replace any existing parking stall power outlet. It measures temperature and wind chill and is factory programmed to automatically regulate the optimum power flow to ensure strong starts at any temperature. Each IPLC handles two circuits and is provided with factory programming. Each outlet can be individually programmed to suit specific needs.¹⁷

Periodical checks on lighting fixtures, electrical outlets and switches should be done in conjunction with building walk down inspections.



Basic Preventative Maintenance Tasks for Electrical Systems & Components:

- **CHECK:** Burnt out lamps; replace as needed
- **CHECK:** Cycling or flickering lamps; replace as needed.
 - Replacing lamps when lamps are first noticed to cycle will prevent further damage to ballast. Check ballast integrity when changing lamps.
- **LISTEN:** For any unusual or humming noises from fixtures.
 - A humming noise from a fluorescent light fixture usually indicates a bad ballast.
- **CHECK:** Discoloration of housing, damage or deterioration; replace as needed.
- **CHECK:** General condition of receptacles.
 - Looking for a secure tight fit to the wall, no damage to the receptacle or plate cover
- **CHECK:** Condition of all cover plates.

¹⁷ IPLC.com - <https://www.iplc.com/m210>

- Ensure that all plates are in place, secure with no broken areas
- **CHECK:** Any discoloration of cover plate.
 - Discoloration would indicate that a possible short had occurred on the circuit.
- **CHECK:** All switches; ensure switches are functioning properly.
 - Switches should not be loose when operating and ensure they do not spark when turning on or off.

**Emergency/Exit Lights (Reviewed in the Fire – Life- Safety System Below)

FIRE -LIFE-SAFETY (FLS):

Fire-Life- Safety (FLS) systems for any facility or building are the highest priority for the health and safety of the occupants of a building and must be kept in optimum and peak working order and condition.

The best Fire Prevention system is prevention. Prevention includes:

- Keeping debris and items (especially flammable items) away from heat sources.
- Electrical Hazards – do not overload electrical circuits especially with extension cords.
- Smoking – Smoke only in designated areas and deposit smoking materials in proper disposal containers
- Matches & Lighters – keep matches and lighters away from children or others who may
- Proper storage and handling of combustibles and flammable material and liquids – never store in or near mechanical or furnace rooms or sources of heat

Components of a Complete FLS Safety System Include:

- Fire prevention Plan:
 - What To Do in Case of Fire Plans
 - Fire Marshalls
 - Posted Evacuation Routes/Extinguisher location/Muster Point
 - Training on use of Extinguishers
 - Fire Drills
- Detection:
 - Smoke/Heat Detectors
 - Pull Stations
 - Alarm Panels
 - Suppression
 - Extinguishers
 - Hose and & Hose Cabinets
- Signage:
 - Location of pull station signs
 - Location of Fire Department Connection
 - Location of Emergency Doors
 - Proper and approved Exit signs

- Location of Extinguishers & Hose Stations
 - Sprinkler Systems
 - Standpipe
 - Fire Hydrants
 - Emergency Lighting
- Location of Alarm Panels

Basic Preventative Maintenance Tasks for Fire – Life - Safety

- Visually Inspect all Fire Extinguishers Monthly. Ensure that the gauge is working and that the dial is in the “Green Zone”. Ensure that the safety pin is secure. Give the extinguisher a “Shake” to determine whether the extinguisher is full. The contents of the extinguisher should be felt moving on the inside. Record inspection on Fire Extinguisher Inspection Tag.
- Visually inspect all Pull Stations monthly. Ensure they are all intact.
- Visually inspect all Hose and Hose Cabinets. Ensure all components are intact. Clean cabinet if necessary. Record Inspection on tag.
- Test Emergency Lighting. Emergency Lighting be tested by pressing the test button on portable battery pack wall mounted units or by turning off the breaker on direct wire systems. Have any defective battery packs or lights replaced. Record test date on tag attached to the unit.



- Visually inspect all Emergency Exit Lights and Signs. Ensure that the lights work on all signs and that the signs point towards the emergency exit doors.
- Visually inspect all Emergency Exit Doors. Ensure that all doors open freely when pushed and that no debris or materials are in front or behind the doors and obstruct the opening of the doors.
- Visually inspect the Fire Panel for any trouble lights that may be indicated. Check for last test date.
- Visually check Fire Standpipe System for proper pressure, any leaks and verify last test date.
- Visually inspect Fire Department Connection. Check that connection area is free and clear and that all caps are in place.
- Visually check that all related signage is in place and in good order.
- Visually inspect all Sprinkler Heads to look for any damage or missing parts.
- Visually inspect entrance ways into facility to ensure path is free and clear for emergency vehicles.
- If a commercial kitchen is in facility, visually check all range hoods for buildup of excess grease and combustible deposits. Arrange cleaning is necessary assist in planning and conducting semi-annual Fire Drills.



- Arrange for a Professional Fire Protection company to conduct a complete annual service on all FLS systems and components and repair all noted deficiencies.

PLUMBING

A plumbing system consists of three separate parts: an adequate potable water supply system; a safe, adequate drainage system; and ample fixtures and equipment. The generalized inspection of a home is concerned with a safe water supply system, an adequate drainage system, and ample and proper fixtures and equipment.¹⁸

It has also been defined as “a system of pipes and fixtures installed in a building for the distribution and use of potable (drinkable) water and the removal of waterborne wastes. It is usually distinguished from water and sewage systems that serve a group of buildings or a city.”¹⁹

Additional components of a plumbing system include: but not limited to; the sump pump, backflow preventers, water heater, recirculation pumps and the valves.

Sump Pump/Pit:

The Sump Pump / Pit area consists of the storage area, ejector pumps, level and float switches.

The level switches allow the system to operate automatically when fluids reach predetermined levels.

Level switches control the on, off, high level alarm and override functions

Sump pumps should be tested and cleaned at least semi-annually. A sump pump can be tested for proper operation by unplugging the cord to the pump motor (not the float) and plugging it back in again. There should be a sound from the motor. A simple way to test a sump pump is by pouring water into the pit until the pump operates.

Depending upon the area and amount of use, a sump pump should be replaced every 5-10 years.



¹⁸ National Association of Home Inspectors - <https://www.nachi.org/plumbing-terms.htm>

¹⁹ The Editors of Encyclopaedia Britannica - <https://www.britannica.com/technology/plumbing>

Basic Preventative Maintenance Tasks for Sump Pumps:



NOTE:

Before attempting any entry into a sump pit and perform service on a sump pump, please note the following:

- Wear a rubber apron, gloves, boots, full face shield, and respirator when performing the work. If a person must enter the pit, test for oxygen deficiency and supply proper ventilation equipment as needed. No open flames or smoking and make sure electrical systems are locked out and tagged.
- Open/disconnect and tag electrical circuits.
- Remove cover plates, Flush pit, and pump out
- Check bail, floats, rod, and switches – Make sure switches operate as designed.
- Clean pump and lubricate as required.
- Inspect and lube motor. Repack if needed.
- Inspect Check Valves
- Inspect interior of pit for cracks
- Clean motor with vacuum or low pressure air (less than 40 PSI)
- Check for corrosion. Clean and treat with rust inhibitor as needed.
- Inspect cover plate gasket and replace if necessary.
- Strainer cleaning requires removal of pump unit and should be handled as a repair.

If any of the above maintenance items cannot be performed by local staff, the service should be performed by a professional plumbing company.

Back Flow Preventers:

Back flow preventers are used to protect potable water supplies from reverse flow contamination. The preventer consists of an intermediate relief valve in a low -pressure zone between two in-line and independent check valves.





If pressure on the supply side drops to equal or less than the discharge side, the check valves close and the trapped fluid is discharged by the center relief valve. According to code, Back flow preventors must be inspected annually. The inspection should be recorded on a tag on the unit.

Basic Preventative Maintenance Tasks for Back Flow Preventors:

This maintenance should be done annually. Schedule outage of equipment with the building users. Review the manufacturer's instructions for testing the valve and proper use of the test equipment involved.

Secure incoming water lines:

- Check and test the following:
- Test for objects lodged in the seat or disc.
- Test for worn or loose disc or disc guide assembly.
- Check for damage to seat.
- Check for corrosion build-up.
- Check and calibrate according to manufacturers' instructions.
- Following manufacturer procedures, vent both chambers and return the system to normal operation.

If any of the above maintenance items cannot be performed by local staff, the service should be performed by a professional plumbing company.

Water Heater:

The water heater converts energy to heat and transfers that heat to the water.

Water Heaters are connected to a cold-water supply pipe and has an outgoing hot water pipe or system of pipes that supplies heated water to the faucets and appliances





Traditional Water Heaters are fired by natural gas or electricity and heat water stored in a tank.

Tankless Flow-through Water Heaters are being utilized more due to their energy efficiency and the size.

Basic Preventative Maintenance Tasks for Water Heaters:

Maintenance for water heaters should be at a frequency of semi-annually. Review manual and instructions prior to performing the maintenance:

- OBSERVE – Check area around and under the water heater for any noticeable leaks or stains.
- CLEAR – Any debris, garbage or any other material away from the heater.
- LISTEN – Newer Energy Efficient water heaters have a fan or draft inducer on top.
 - Check for unusual noises that would indicate wear on the inducer.
- CLEAN – Keep pumps clean from dust, dirt and debris by cleaning or using compressed air.
- CHECK overall condition of tank for rust or deterioration.
- INSPECT water piping for leaks and corrosion.
- REMOVE sediment -draining water from heater until it runs clear.
- CHECK all electrical connections.
- CHECK all gas connections-use soap water test.

Piping:

Maintenance checks on piping and pipe insulation should be done annually.



Basic Preventative Maintenance Tasks for Piping:

- INSPECT water piping for damage, leaks and corrosion.
- CHECK condition of insulation for rips, tears or missing sections.
- CHECK pipe hangers for damage, corrosion and integrity.
- CHECK pipe supports are stable and secure.

Plumbing Fixtures:

The plumbing fixtures include but are not limited to sinks, faucets, toilets, and urinals.

Properly functioning and well maintained plumbing fixtures are essential to the health and safety and overall satisfaction of the building occupants.

This maintenance should be done as frequent as quarterly. Check and inspect the following:

Toilets:

- Inspect for general condition and fastening to the floor. Tighten as needed.
- Check operation of water shut off valve.
- Check seat and hardware. Tighten or replace seat as required.
- Check Flush assembly operation; ensure proper water level, operation of float, flush handle, and shut off valve. Adjust as required.
- Check for leaks or signs of leaks around toilet.
- Check handicap hand rail for tightness. Tighten as required.
- Check waste supply line for leaks or deterioration.
- Apply Liquid chemical drain cleaner.



Urinals:

- Check general condition of urinal for cracks and/or leaks.
- Check mounting and secureness.
- Check flush valve operation. Adjust or replace if necessary.
- Apply liquid chemical drain cleaner.



Lavatory/Sinks:

- Check operation of water shut off valves.
- Check operation of faucets, leaking and tightness. Repair as required.
- Check drain, trap and waste arm for leaks and deterioration.
 - Tighten or repair.
- Check stopper mechanism for leaks or deterioration.
- Check water supply lines for leaks or deterioration.
- Apply liquid chemical drain cleaner.



MECHANICAL/HVAC

The Heating, Ventilation and Air Conditioning (HVAC) system and related mechanical systems are a major capital cost and ongoing maintenance expense of any facility.

As well, a proper and well managed HVAC system is vital not only to the condition of the building envelope, but as well, vital to the health and safety of all building occupants.

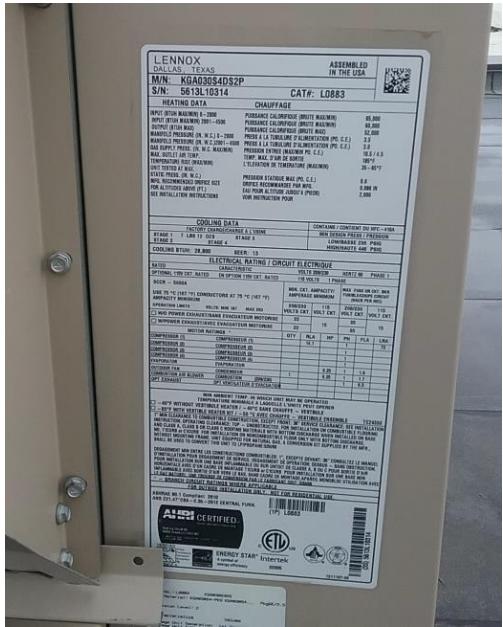
Unfortunately, many HVAC systems have not been properly and regularly maintained causing health and safety issues and as well, major repair and replacement costs for the building owner.

An initial priority for proper HVAC Maintenance is to fully catalogue all HVAC Equipment.

As well, when inspecting or servicing any piece of HVAC Equipment take lots of pictures, especially including the name plate and any noted or observed deficiency.

Log Books and Preventative Maintenance (PM) Sheets should be created for all HVAC Equipment. The Log Book should contain the Make, Model, Serial number and if possible, the "*In Service Date*". The make, model and serial number are usually found on the name plates attached to each piece of equipment.





The Log Book and PM Sheets should also contain all service information such as the Dates of Service, who provided the service, what was done and general comments from the service provider.

PM Sheets should also contain additional information for each piece of HVAC Equipment such as frequency of service, maintenance priority, procedure of maintenance and who is assigned to perform the service.

There should be a maintenance plan for two “Professional” & Thorough Services
Spring Shutdown & Fall Startup (Heat)
Spring Startup and Fall Shutdown (Cooling)

During annual, semi-annual, quarterly or monthly inspections the following should be recorded on some form of an Asset Condition Report.

- The General Condition, (New, Good, Fair, Poor) based on general observation or information from an HVAC Service Provider
- Deficiencies that require immediate service
- Date of last service
- Plan for correction of Immediate deficiencies
- Recommendation for replacement of various HVAC Components such as pumps, motors, fans etc.

Boilers:

Boiler systems are major financial investments, yet the methods for protecting these investments widely vary.

Proper maintenance and operation of boiler systems is important with regards to efficiency and reliability. Without this attention, boilers can be very dangerous. It is estimated that with proper maintenance, a boiler should last between 25-30 years.

Boilers are fired by natural gas, heating oil or electricity. They can be classified in three main divisions: fire-tube boilers, water-tube boilers, and electric boilers.

Water Tube Boilers:

Most high-pressure and large boilers are of this type. It is important to note that the small tubes in the water-tube boiler can withstand high pressure better than the large vessels of a fire-tube boiler.

In the water-tube boiler, gases flow over water-filled tubes. These water-filled tubes are in turn connected to large containers called drums.

Boiler sizes range from smaller residential type to very large utility class boilers. Boiler pressures range from 15 psi through pressures exceeding 3,500 psi.

Boilers still in use in many facilities include older style, Warden King, Dominion or Exbrook “Cast Iron” Boilers that have been in service for decades and smaller Boilers such as Raypak, Weil McLain and others.



The Safety and Inspection of all heating Boilers in the province of Alberta with a heating surface over 2 square meters are under the control of the Alberta Boiler Safety Association (ABSA). Documentation of a respective Boiler will verify the size of the heating surface.

ABSA's Mandate is: “ABSA, as a regulatory authority in Alberta, works with our stakeholders to ensure that pressure equipment is designed, constructed, installed, operated, maintained and decommissioned in a manner that protects public safety.”²⁰

Boilers are rated according to their Annual Fuel-Utilization Efficiency (AFUE) Rating or score.

²⁰ ABSA Website: <https://www.absa.ca/about-absa/mandate/>

Boilers today must have an AFUE Rating of at least 80%. Older Boiler could have an efficiency rating as low 65% or lower depending on the age and type of boiler.

Boilers common today for new installations, upgrades or replacement are High Energy Efficient Condensing Boilers. High-Efficient Condensing Boilers have an efficiency rating between 90 - 96%.



Boiler Maintenance:



NOTE: Before attempting any visual inspections of or entering any mechanical or boiler room, ensure that all safety precautions and PPE equipment, especially the use of safety glasses are followed.

Poor maintenance practices or a defective low water cut-off causes most boiler incidents, including those that result in injuries and building damage.

Routine maintenance is critical to ensure a boiler system remains reliable, safe and efficient.

As always, for any boiler repair or maintenance, follow your manufacturer's recommendations for routine maintenance recommendations.²¹

Boiler Maintenance begins with visual inspections and observations. Look for signs of Boiler or Boiler Component failure such as water on the floor, corrosion on pipes, fittings, filters, water and relief valves and especially the condition of the boiler water through site glasses.



As well as visual inspections and observations, a keen ear in furnace, boiler or mechanical rooms can be crucial in preventing Boiler and Boiler component failure. A squealing, grinding or screeching sound either continual or intermittent is sign of worn bearings in pumps, motors and pulleys and compressors.

Visual inspections and observations include temperature and pressure readings, conditions of belts and pulleys and the amount and condition of boiler glycol and boiler water treatment.

Boiler water treatment is used to prevent damage to the boiler and components by treating the water with various chemicals to prevent scaling, rusting, corrosion or other harmful side effects that could damage a boiler and related components.²²

Glycol is used to prevent boiler water from freezing as it travels throughout the radiant heating system. This is especially critical as many boiler radiators are located next to exterior walls.

The key to initial preventative maintenance for Boilers and HVAC systems is to “Listen and Observe” at all times. Often HVAC component failure can be detected through vent openings either by sound or by odor.



NOTE: Importance of a Low Water Cut Off Devices:

An undetected defective low water cut off device will cause catastrophic boiler failure. According to ABSA, the most common cause of Boiler Accidents in the Province of Alberta is in Alberta, when the burner continues to fire after the boiler water level drops below the minimum safe operating level.²³

Low water cut off devices are designed to shut down a boiler in the event of recognized low water. Manufacturers recommendation for water level must be maintained at all times.

Failure of low water cut off devices (LWCO), could be caused by age, buildup of sediment in device and as well, lack of proper maintenance.

²² Guardian Chemicals Inc. 155-55202 SH 825 Sturgeon Industrial Park, Sturgeon County, AB

²³ ABSA Website: <https://www.absa.ca/inspections/owner/faqs/>



LWCO devices must be maintained and parts replaced according to manufacturer recommendations. These devices also need to be flushed out periodically to prevent deposits from accumulating within the LWCO. These are relatively low-cost actions that can greatly reduce and prevent property damage and personnel injuries.²⁴

It is noted that a clean, organized work environment which includes clean, dirt, dust and grime free components, including LWCO devices and other HVAC and Boiler equipment and components, is an essential part of HVAC/Boiler maintenance and will lead to extending the life cycle of many components.

Daily Boiler Maintenance Tasks:

Visual/Physical Inspection:

- Check for Leaks on Floor & Clearances around Boiler & HVAC Equipment
- Check Temperature & Pressure Readings. Record on Log Book
- Check for Error Codes
- Check Flame Color & Consistency
- Pumps/Belt/ Pulleys - Visual Inspection

Weekly / Monthly Boiler Maintenance Tasks:

- Check Low Water Cut-off for proper operation
- Operation of valves
- Check Motors for proper operation & sound
- Gauge Glass Condition & Condition of Water
- Lubricate Pumps (If able)
- Check Glycol Level
- Check Filters & Strainers. Clean and/or replace if necessary.
- Check Condition & operation of Relief Valves



Semi – Annual Boiler Tasks:

- All Monthly Boiler Maintenance Tasks PLUS the following:
- Remove and inspect the low water cut-off and its interconnecting piping.
- Pay close attention to the condition of the head assembly's wiring and switches.
- Check the pump alignment on all the base-mounted pumps in the boiler room.

²⁴ Brian W. Moore, P.E., 2020 the Hartford Steam Boiler Inspection and Insurance Company. All rights reserved

Annual Maintenance Boiler Tasks:

- Shut Down
- Inspection of Tubes,
- Check Boiler Insulation for degradation
- Check Condition of Heat Exchanger
- Check all valves for Corrosion and proper functioning
- Check operation of Igniter/Sensors
- Check Burner Assembly for wear, holes corrosion etc.
- Check Relief Valves for corrosion & proper functioning
- Check All Boiler Controls & Controllers
- On the control panel, ensure that all of the electrical connections are tight
- Chimneys & Vents
- Check Zone Valves on Radiant Heating
- Check all Radiators for Corrosion and proper functioning
- Check and/or Replace Glycol and water treatment – PH Levels
- Check the safety valve to make sure there is no sign of leakage.
- Inspect additional accessories that may be part of the boiler system



Sample Boiler / Heating Checklist:

Building - Heating Checklist				
Date:	Facility:			
Name:	Community:			
<small>Confirm specific item with the description. Leave section blank if the item does not exist.</small>		Choose one		
		Satisfactory	Unsatisfactory	<i>If unsatisfactory, describe problem(s)</i>
Boiler Systems				
Forced Air Furnaces				
Re-Heat coils				
Radiant Tube heaters				
Heating Coils				
Burners				
Pressure Gauges				
Zone Valves				
Radiators				
Glycol Testing				
Circulating Pumps				
Soot Collection / Cleaning				
Exhaust Flue / Chimney				
Fuel Tanks / Lines				
Isolation Valves				
Fuel Filters / Condensate Traps				
Switches / Controls				
Tag-out / Lock-out				
Other:				
<u>General Remarks:</u>				

Other Boiler – HVAC Related Equipment:

Other equipment/components that are required and related to a Boiler Heating System include:

- Thermostat
- Expansion Tanks
- Pumps
- Motors
- Compressors
- Ducting/Venting
- Air Handling Units

Thermostats:

A properly functioning Thermostat is probably one of the most important but often overlooked items in HVAC Maintenance and Repair.

Thermostats are key to providing proper heat and cooling to various areas of the facility.

Older style “Mercury” switch thermostats and other “standard” dial or slide thermostats should be replaced with Programmable and preferably a “locking” type thermostat.



Programmable Thermostat will provide energy efficiency by programming the required hours and days to provide the optimum heating and cooling temperatures during occupied and unoccupied times and days.

A “Locking” style of Thermostat will prevent unauthorized people from changing set temperatures and hours of operation. It is recommended that if heating is set at 21°C then cooling should be at 25°C. This 4°C range is referred to as “Deadband”.



Smart Thermostats such as the Honeywell RTH9580WF provide remote access capabilities through Wi-Fi connection.

Not only can the temperature be adjusted from remote locations, through the Honeywell Total Connect Comfort program and app, heating/cooling schedules can be changed, outdoor air temperature can be viewed and an override condition to current schedules can be created to accommodate unscheduled events and activities in a building. Other remote features are also available. Such as current status, occupancy mode, fan operation, and various fault codes of HVAC equipment. Additional or modification of current thermostat wiring may be required for proper operation.

Expansion Tanks:



An expansion tank in a Boiler System handles the thermal expansion of water as it heats up and provides the excess water and water pressure from thermal expansion a place to go.



Air pressure is required inside the tank to absorb the pressure from the boiler water entering the tank. When water heats up it expands and needs some place to go and that safe place is an expansion tank.

Preventative Maintenance on Expansions tanks involves visual inspections of leaks, corrosion on fittings and water visible in the site glass if provided and proper operation and condition of the relief valve. Lack of water in the site glass may indicate further boiler problems.

As well, an expansion tank, if properly sized, should only be about half full of water. Tapping

on the top of the tank will indicate how full the tank is.

Also, the difference of the water temperature in an expansion tank should cause the sides of the tank to feel warmer on the bottom of the tank than on the top of the tank.

Any major repairs or replacement of an expansion tank should be performed by a professional HVAC service company.

Pumps:

Circulating pumps in a closed loop Boiler system moves the hot water from the Boiler throughout the piping and loops in a building to heating components such as radiators, baseboard heaters and other type of heating components.



Basic Preventative Maintenance Tasks for Circulating Pumps

- OBSERVE – Check pump and area around the pump for any noticeable leaks or stains.
- LISTEN - Check for unusual noises that would indicate bearing wear, cavitation (bubbles or air pockets), and other problems.
- CLEAN – Keep pumps clean from dust, dirt and debris by cleaning or using compressed air.
- ALIGNMENT – Ensure pump is properly aligned into place and has not shifted due to wear or running
- COUPLINGS & FITTINGS – Ensure all couplings and fittings associated with the pump are tight and in good condition.

Motors:

Motors drive critical components of an HVAC System such as fans, Air Handlers, blowers and pumps.

Most motors used in the past are traditional single speed, on or off, AC motors. However, VFD (Variable Frequency Drive) motor controllers are now being utilized for more HVAC applications such as pump and fan motors.



Variable Frequency (VFD) motor controllers, as the name suggests, have the advantage of reducing and adjusting speed according to load and demand.

It is estimated that the use of VFD controllers can save approximately 50-60% in energy costs over traditional AC single speed motors.

Basic Preventative Maintenance Tasks for Motors



- OBSERVE – Check motor and area around the pump for any noticeable leaks
- LISTEN - Check for unusual noises that would indicate bearing wear, other problems.
- CLEAN – Keep motors clean from dust, dirt and debris by cleaning or using compressed air.
- ALIGNMENT – Ensure motor is properly aligned into place and secure and has not shifted due to wear or running
- FITTINGS – Ensure all and fittings associated with the motor are tight and in good condition especially the pulley.
- LUBRICATE – Some motors have an access hole for oil. Lubricate motor with recommended oil.

Compressors:



NOTE: ALL COMPRESSORS SHOULD HAVE PROPER GUARDS INSTALLED OVER ALL MOVING PARTS SUCH AS MOTORS, PULLEYS & BELTS.

Compressors are used in HVAC systems for HVAC pneumatic controls and related devices.

Reciprocating/piston air compressors are complex machines with many moving parts. Regular maintenance is essential for ensuring all compressor parts and components function at peak efficiency as well as for preventing wear that can ultimately lead to premature failure. The following tips can serve as guide for safe, reliable and economical reciprocating



compressor operation and maintenance.

Keeping the Compressor Clean:

Excess dirt and debris is a major cause of premature compressor failure. Compressor operators play an important role in the preventive maintenance process by watching for the accumulation of dirt during use and removing it as quickly as possible.

Minimizing Vibrations:

Vibration is a common issue that can lead to reciprocating compressor failure. Vibration is typically a result of the compressor not being properly secured. Constant vibration will eventually cause compressor parts and components to loosen, leading to parts misalignment, excessive wear on the bearings and other more serious mechanical problems.



Proper Piston Compressor Lubrication:

The failure to properly lubricate a piston compressor will lead to the development of friction that causes parts to wear down. In general, piston compressor lubrication entails the compressor frame, which includes the connecting rod, crosshead, motor and main bearings. It also encompasses the cylinders, including the valves, compression rings, rider bands and packing.

Piston Compressor Oil Maintenance:

When to add or change reciprocating air compressor oil will depend on factors such as the model type and operating conditions. In general, manufacturers recommend changing the oil on a quarterly basis, but more often with greater use. The operator should also regularly monitor the fluid level and add oil as necessary.²⁵

²⁵ All Above Maintenance Information Courtesy of Quincy - Reciprocating Compressors Oil and Maintenance, Quincy Compressors <https://www.quincycompressor.com/products/reciprocating-piston/oil/>

Basic Preventative Maintenance Tasks for Compressors



NOTE: COMPRESSORS HAVE MOVING PARTS. BEFORE ATTEMPTING ANY MAINTENANCE ON AIR COMPRESSORS ENSURE THAT POWER TO THE UNIT IS DISCONNECTED AND THAT LOCK OUT/TAG OUT PROCEDURES ARE IN PLACE.

- *OBSERVE – Check compressor and other areas for any noticeable air and other leaks and loose components*
- *LISTEN - Check for unusual noises that would indicate wear, loose belts or other problems.*
- *CLEAN – Clean off grease, dust, dirt and debris*
- *INSPECT - Electrical wiring, Filters, Condition of belt and guarding.*
- *LUBRICATE - Check the oil level (if your machine is oil lubricated).*

Ducting and Venting:

Buildings and Facilities have an enormous amount of ducting and venting to provide distribution of heated and cooled air throughout a facility.

However, ducting and venting are often overlooked in Building Maintenance and Preventative Maintenance.

Air ducts and vents may also house other HVAC components such as dampers, fans and VAV boxes. VAV or Variable Air Volume boxes are placed inside ducts and vents in order to control the volume of air flowing to different areas of a facility.

Dampers are plates that open and close and are controlled pneumatically or by electronic means. Dampers can restrict or open the flow of air ducting, vents and to VAV boxes.



Basic Preventative Maintenance Tasks for Ducting & Venting

- *OBSERVE – Check ducts and vents (where possible) for breaks at joints, cracks and secure and sealed taping,*
- *LISTEN - Check for unusual noises coming from vents that would indicate other HVAC problems.*

CLEAN – Cleaning of ducts and vents are often overlooked. Vents periodically need to be cleaned especially on top of open ducts and vents and inside ducting and vents. Clean vents are important to IAQ, and also reduces the risks of fire occurring inside venting and ducting. Vents and ducts that are not cleaned inside on a regular basis can be a source of mold and other indoor air contaminants. Noticeable odors coming from ducts and vents clearly indicate that mold or other contaminants are present.

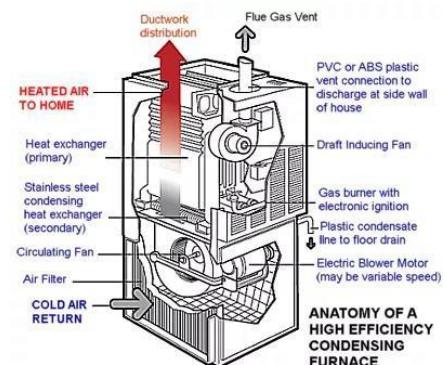
Furnaces:

Forced air furnaces are a common form of heating in smaller facilities or selected areas of larger building.

Forced air furnaces in the past were relatively simple and had very few parts such as, a gas valve, burner assembly, motor & blower assembly and a filter. These older style furnaces were also not very fuel efficient.

Forced air furnaces today are now High Efficient, with efficiency ratings around 95%. However, the high efficiency may demand a greater level of service and service with some additional costs.

For example, a main component in all High Efficient Furnaces is the control main circuit board. The cost of a circuit board alone could be around \$250.00.²⁶



²⁶ The Spruce - <https://www.thespruce.com/high-efficiency-condensing-furnace-4117111>



One estimate of supply and installation of a main board through an HVAC Service Company is between \$600.00 - \$1,800.00.

Other parts in a high efficiency furnace include, blower or draft inducer motors, electronic ignition module and a filter.

Most blowers or draft inducers motors on High Efficient Furnace run at variable speed depending on the load.

The filter on all types of furnaces is probably the most important, but often the most overlooked replacement part in preventative maintenance.

Furnace filters need to be replaced regular and the frequency depends on the demand and area of service. Dirty or dusty locations require more frequent replacement.

High quality pleated furnace filters are recommended in order to provide the optimum filtering capability and extended lifespan.

It is recommended that the size and preferred type and filter number be recorded in a visible place adjacent to the furnace in order to provide consistency in replacement.

Basic Preventative Maintenance Tasks for Forced Air Furnaces:



NOTE: BEFORE ATTEMPTING ANY INTERNAL SERVICE ON FORCED AIR FURNACES ENSURE THAT ALL POWER TO THE FURNACE IS TURNED OFF.

LISTEN - Check for unusual noises or that would indicate bearing wear, other problems
Remove doors or cover. Often there is a top and bottom door.

OBSERVE – Check floor and under and around furnace for water leaks.

OBSERVE – Check inside furnace for any



Standing water, loose or missing parts

- *REPLACE – Furnace filter with high quality filter.*
- *CHECK – If a humidifier is connected to the furnace, examine humidifier area and filter for scaling and blockage of ports. Replace or clean humidifier filter if heavy scaling is visible.*

Air Conditioning:

Packaged Rooftop Units (RTU):

A common form to provide Air Conditioning to a small to large size commercial building is through a packaged Rooftop Air Conditioning (AC) unit.

These units are self-contained and unlike a split-system AC unit found in homes, do not require any additional components, except venting, to operate.



The basic components of a packaged roof top unit include: air filters and inlet screen filters, fan housing and motor, belts, coils, blowers and motors.

RTU's are rated in Tons, which is the cooling capacity of the Air Conditioning system.

It is recommended that RTU's be inspected and serviced quarterly. Location and demand may require more frequent service.

Basic Preventative Maintenance Tasks for Packaged Roof Top Units (RTU):



NOTE: ROOFTOP UNITS CONTAIN FAST MOVING ROTARY PARTS. BEFORE ATTEMPTING ANY SERVICE ENSURE THAT ALL POWER TO THE FURNACE IS TURNED OFF AND LOCKOUT/TAG PROCEDURES ARE FOLLOWED.

Belts according to manufacturer's recommendations.

- *LISTEN - Check for unusual noises or that would indicate bearing wear, other problems*
- *POWER OFF: Turn power off. Use lockout/tag out.*
- *OPEN or Remove Doors or Cover*
- *OBSERVE – Check floor inside and under for leaks.*
- *INSPECT - Condition of belts, motor, pulleys, fans, and especially coils*
- *REPLACE – Filters with high quality filters.*

- *REPLACE – Belts if worn or frayed. Tighten according to manufacturer's recommendations.*
- *INSPECT – Fan, motor and housing for dirt build up cracks and corrosion and wear*
- *INSPECT & CHECK - Condition of wiring. Make sure all wires are tight.*
- *CLEAN – Coils, motor, housing, fan, inside unit, air intake and outlet.*
- *CLEAN – Drainage area inside RTU. Ensure dirt and debris are removed*
- *LUBRICATE – Motor bearing every six months (if possible)*
- *CHECK – If qualified and equipped, check refrigerant pressure during operation of the RTU.*
- *REPLACE – All panels removed and tightened all necessary screw to secure panels.*
- *COMB & CLEAN – Coil fins if damaged by weather or other means.*



Air Handling Unit (AHU):

An Air Handling Unit (AHU) is used to re-condition and circulate air as part of a heating, ventilating and air-conditioning system.

The basic function of the AHU is to take in outside air, re-condition it and supply it as



fresh air to a building. All exhaust air is removed, which creates an acceptable indoor air quality. Depending on the required temperature of the re-conditioned air, the fresh air is either heated by a recovery unit or heating coil, or cooled by a cooling coil.²⁷



An AHU is usually located on top of a roof. For more optimum air flow and greater efficiency, often multiple AHU's are preferred for a building instead of one large AHU.

Basic Preventative Maintenance Tasks for Air Handling Units:



NOTE: Air handling units have moving parts. Before attempting any maintenance on AHU's ensure that power to the unit is disconnected and that lock out/tag out procedures are in place.

- **OBSERVE** – Check AHU and area around AHU for any noticeable leaks and vibration problems.
- **LISTEN** - Check for unusual noises that would indicate bearing wear, other problems.
- **CLEAN** – Keep AHU clean from dust, dirt and debris.
- **CLEAN** – Clean coils and drain pan, Fan housing and Fan Blades
- **ALIGNMENT & TENSION** – Check the condition and alignment of belts. Replace belts regularly – before they fail.
- **CHECK** – CLEAN and preferably REPLACE ALL FILTERS
- **LUBRICATE** – Some motors have an access hole for oil. Lubricate motor with and other moving parts recommended oil.

²⁷ Grundfos - <https://www.grundfos.com/service-support/encyclopedia-search/air-handling-unitahu.html>

JANITORIAL SERVICES

In any facility, detailed, well planned and thorough janitorial services are crucial to a healthy and sanitary environment for all building occupants.

Janitorial services include cleaning schedules of all areas of a facility based on daily, weekly, monthly and other frequencies.

Janitorial tasks and cleaning schedules are essential in order to maintain a respectable standard and high level of cleanliness in each area of a facility.

In performing Janitorial Services, it is important to know the difference between cleaning, disinfecting and sanitizing:

Cleaning removes germs, dirt, and impurities from surfaces or objects. Cleaning works by using soap (or detergent) and water to physically remove germs from surfaces. This process does not necessarily kill germs, but by removing them, it lowers their numbers and the risk of spreading infection.

Disinfecting kills germs on surfaces or objects. Disinfecting works by using chemicals to kill germs on surfaces or objects. This process does not necessarily clean dirty surfaces or remove germs, but by killing germs on a surface after cleaning, it can further lower the risk of spreading infection.

*Sanitizing lowers the number of germs on surfaces or objects to a safe level, as judged by public health standards or requirements. This process **works by either cleaning or disinfecting** surfaces or objects to lower the risk of spreading infection.²⁸*

The frequency for cleaning of any surface is dependent on where the surface is located and the frequency of use. Clean and disinfect surfaces and objects that are touched often.

According to the Centers for Disease Control and Prevention, a guideline to follow is as below:

"Typically, this means daily sanitizing surfaces and objects that are touched often, such as desks, countertops, doorknobs, computer keyboards, hands-on learning items, faucet handles, phones, and toys. Some schools may also require daily disinfecting these items. Standard procedures often call for disinfecting specific areas of the school, like bathrooms.

Immediately clean surfaces and objects that are visibly soiled. If surfaces or objects are

²⁸ Centers for Disease Control and Prevention: <https://www.cdc.gov/flu/school/cleaning.htm>

soiled with body fluids or blood, use gloves and other standard precautions to avoid coming into contact with the fluid. Remove the spill, and then clean and disinfect the surface.”²⁹

In order to provide an acceptable level of janitorial service for any facility, the appropriate and necessary cleaning equipment and supplies are required.

Typical Janitorial equipment and supplies include, but not limited to:

- *Floor mops standard or microfiber and dustpans*
- *Wet mops and Bucket/ringer*
- *Good Quality Commercial Vacuum*
- *Janitorial caddy or cart*
- *Floor Scrubbers*
- *Microfiber cloths*
- *Sponges*
- *Toilet brush*
- *Good Quality Protective Gloves*
- *Cleaning tasks chart*
- *MSDS Sheets (Material Safety Data Sheets) for all chemicals.*
- *Good quality environmentally friendly cleaning solutions/products*
- *Replacement receptacle liners*



T500 / T500e Walk-Behind Floor Scrubbers | Tennant



In most commercial facilities, the main cleaning activities take place in the late afternoon or evening.

However, all supplies and equipment need to be readily available for any incident that

²⁹ Centers for Disease Control and Prevention: <https://www.cdc.gov/flu/school/cleaning.htm>

happens at any time during the day.

In using any cleaning chemical, always follow label directions for use or mixing on cleaning products and disinfectants. Always ensure that any safety warnings on labels are followed.

Washrooms should always receive daily priority attention and should be inspected often for sufficient supplies and cleanliness especially around toilets, urinals and sinks.

It is vitally important to keep all high traffic areas free from slip and trip hazards such as wet floors when cleaning or in the winter, or extension cords when operating equipment.

Warning signs and cones must be used in areas and condition that may cause injury to building occupants.

Along with floors, fixtures including light fixtures and door handles or any other horizontal surface should receive dusting and cleaning.

An area that is often overlooked in janitorial service is high cleaning or high dusting. High dusting is the cleaning of areas that are normally difficult to clean because of their height such as vents, piping, and ceiling. High dusting is often referred to areas above 16' high. Special equipment and training is important when performing high dusting services.

Finally, all janitorial supplies and equipment should be kept in a neat, well organized cupboard or room.



Note on Handling Human Waste:

If any human waste must be handled or disposed of, please note the following:

- Always wear proper PPE, rubber gloves, mask or face shield.
- Wash hands with soap and water immediately after handling human waste or sewage.
- Avoid touching face, mouth, eyes, nose, or open sores and cuts while handling human waste or sewage.
- After handling human waste or sewage, wash your hands with soap and water before eating or drinking.
- After handling human waste or sewage, wash your hands with soap and water before and after using the toilet.
- Before eating, removed soiled work clothes and eat in designated areas away from human waste and sewage-handling activities.
- Do not smoke or chew tobacco or gum while handling human waste or sewage.
- Keep open sores, cuts, and wounds covered with clean, dry bandages.³⁰

Janitorial Tasks are Usually Grouped into, Daily, Weekly, Monthly, Semi-Annual or Annual and Periodic Tasks. Daily Janitorial Tasks Include:

- Empty waste bins, wash as needed and add new liners
- Vacuuming all floor areas
- Mop, clean or vacuum all floor surfaces
- Clean all glass surfaces
- Damp-wipe hard surfaces with mild disinfectant
- Clean walls and painted surfaces as needed
- Wipe down door handles, light switches and baseboards
- Sanitize and clean all basins, toilets, doors and fixtures in washroom
- Refill soap dispensers, toilet paper and personal hygiene products.

³⁰ Centers for Disease Control and Prevention: <https://www.cdc.gov/flu/school/cleaning.htm>



Hantavirus

7 Steps to Safe Clean-up of Mouse Droppings, Nests, or Dead Mice

Hantavirus is a severe, potentially fatal, illness. Humans can be exposed to Hantavirus when the urine or feces of an infected rodent become airborne.

This means that anyone who disturbs areas of mice or mice droppings, such as when cleaning, can be at risk. Reduce your risk of illness by following these seven simple – but essential – steps, when dealing with rodent clean-up.

- 1** Open doors and windows and allow the area to ventilate for at least 30 minutes prior to starting your clean-up. Keep out of the area while you let it ventilate.
- 2** Wearing rubber gloves, thoroughly soak droppings, nests and dead mice with a bleach/water solution (one part bleach to nine parts water) or a household disinfectant.
- 3** Let the bleach water solution sit on the droppings/nests/mice, for five minutes. Do NOT disturb any droppings, nests or dead mice, prior to soaking with this bleach solution (for the full five minutes).
- 4** Mop up bleach-soaked droppings, nests and/or dead mice, or pick up with paper towels, placing immediately into a plastic bag.
- 5** Seal the plastic bag completely.
- 6** Put sealed plastic bag directly into a garbage container with a tight fitting lid.
- 7** Wash your gloves before removing, and then wash your hands thoroughly (with warm soap and water).

NOTE: never vacuum or sweep droppings, nests or dead mice. This can create dust that can be inhaled. The dust may contain Hantavirus.

Albertans dealing with significant mouse infestations, and/or mouse infestations in enclosed, poorly ventilated, spaces, should contact Health Link Alberta (1.866.408.5465), to discuss necessary special precautions.

Individuals infected with Hantavirus generally show symptoms one or two weeks after exposure, however symptoms have been known to appear up to five weeks after exposure. Symptoms resemble severe influenza, including fever, body aches, chills, and severe breathing problems.

If you have recently been in an area contaminated by mice, and have developed severe influenza-like symptoms (including difficulty breathing), it is important that you see a doctor immediately.

To learn more about Hantavirus, visit MyHealth.Alberta.ca

Sample Janitorial Checklist:

 FIRST NATIONS TECHNICAL SERVICES ADVISORY GROUP INC.		Janitorial Checklist			
Date:	Name:	Facility: Community:			
<small>Confirm specific item with the description. Leave section blank if the item does not exist.</small>		<small>Choose one</small>		<small>If unsatisfactory, describe problem(s)</small>	
		Satisfactory	Unsatisfactory	N/A	
DAILY					
RESTROOMS					
Clean and sanitize all fixtures and surrounding areas					
Empty waste baskets-change liners if needed					
Stock all dispensers / replace fresheners as needed					
Sweep and wet mop floors					
Clean mirrors					
KITCHEN					
Wipe tables , countertops, and seating areas					
Dispose garbage					
Wash dishes					
BOARDROOMS, OFFICES, WORK STATIONS					
Dust desktops					
Wipe phones					
Dispose garbage					
GENERAL AREAS					
Vacuum / sweep all high traffic areas					
Empty all interior wastebaskets					
Empty all exterior trashcans and cigarette containers					
Vandalism: remove or report within 24hrs.					
Fixtures: Report any non working within 24hrs.					
Drinking fountains-clean and sanitize					
Remove litter: sidewalks and grounds,					
Pick up loose trash around dumpster					
Secure doors					

Sample Janitorial Checklist: Page 2

 FIRST NATIONS TECHNICAL SERVICES ADVISORY GROUP INC.			Janitorial Checklist	Page 2
WEEKLY				
Restrooms				
Clean restroom walls				
Check deodorizers				
Wash vents				
Clean floor drains				
Clean partitions and doors				
Clean sink toilet and urinals				
KITCHENS				
Clean counter appliances				
Empty fridges of perishables, clean as needed				
Clean fridge				
General Areas				
Vacuum all carpets				
Wash floors				
Spot clean carpets as needed				
Empty fridges of perishables, clean as needed				
Wash dishes and clean sinks				
Dust all desks, countertops and office furniture				
Dust window sills and surrounding areas				
Change waste basket liners				
Empty all recyclable containers				
Clean up around dumpsters				
Wash, dust, clean elevators				
Wash windows				
Changed burnt out light bulbs and clean relectors				
Sweep exterior walkways and stairs				
ANNUALLY				
Machine strip and refresh tiled floors				
Steam clean all carpet areas				
Wash exterior windows				
Clean and wash cabinets				
General Remarks:				

