RESEARCH REPORT
Housing Technology Series

Energy and Water Tune-ups Multi-unit Residential Buildings

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Energy and Water Tune-ups for Multi-unit Residential Buildings:

A Guide for Property Owners, Managers and Custodial Staff

Canada Mortgage and Housing Corporation

December 2007

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1. Introduction

1.1 This Manual: What It's About and How to Use It

The Purpose of This Manual

This manual is a tool to help you reduce energy and water bills and improve comfort in your high-rise residential building through low-cost and no-cost tune-up measures. It is intended for both rental apartment and condominium buildings (multi-unit residential buildings, or MURBs).

This Manual Will:

- tell you what opportunities there are to tune-up systems and equipment—along with more detail as to what the tune-ups involve and whether or not you should hire a contractor;
- describes the benefits of tune-up procedures;
- offer some tips on additional actions to consider, including cost-effective retrofit opportunities.

This Manual Will Not:

- describe in detail how your building is constructed;
- replace the operations and maintenance manuals provided by the manufacturers of specific equipment;
- serve as a complete building repair guide or substitute for publications dealing with specific topics (healthy homes, energy efficiency, etc.).

Finding Your Way Through the Manual

Refer first of all to the Table of Contents, which lists every topic covered in the manual and every tune-up procedure included.

Then turn to Section 1.3 "The Tune-up Sequence." This section gives guidance on which systems to tune-up first.

The remaining sections are organized by building system, including:

- Section 2: Building Envelope
- Section 3: Heating and Air Conditioning
- Section 4: Ventilation
- Section 5: Domestic Hot Water
- Section 6: Electrical Systems
- Section 7: Other

Cross-referencing

We have cross-referenced this manual throughout to guide your search for information. For example, the tune-up procedure for electric baseboard heaters, HC-1, concerns the efficient operation of baseboards and thermostats. For information on sealing gaps behind the heaters, references are provided for procedure En-4 in the building envelope section.

Where to Turn for Help

Each procedure has a section indicating whether you are likely to be able to do the work yourself, or whether you'll need to hire someone. If we expect you'll need a contractor, we give you an indication of the type of firm that does that type of work.

Cautions!

Some building tune-up tasks can be dangerous. Before going ahead with a procedure you have not tried before, weigh the risks to your building and your safety. If you are not clear about the problem and how to fix it, or if you are unfamiliar with the tools or uncertain of the skills needed, hire a qualified professional trained to do such work. Even if you don't do the work yourself, this manual will help you understand and manage the work of the contractor.

If you do choose to proceed on your own, wear appropriate protective gear. Always consult the manufacturer's instructions before undertaking maintenance or tune-up work on equipment.

Be aware of code requirements in your area, especially for fuel-fired systems and electrical work. If you are not familiar with code requirements affecting the work, hire a qualified professional.

1.2 Why Tune-up your Building?

Tuning up your building will provide improvements in seven important areas:

- Savings in energy and operational costs
- Better information for making retrofit decisions
- Improved durability of structure and equipment
- Improved safety for your staff and your building's occupants
- Better control of temperature and humidity in the building: more comfortable occupants and fewer complaints
- Improved indoor environmental quality: cleaner air and healthier occupants
- Demonstrated owner commitment to the overall well-being of the building

Energy and Operating Cost Savings

The total cost of providing energy and water to a high-rise building with 40 apartments can exceed $20,000 per year. A comprehensive tune-up, improving envelope, HVAC systems, lighting, appliances, and other systems, can save up to 20 per cent of annual energy and water costs. In a building with 40 units, that could be a savings of $4,000 per year.

Better Retrofit Decisions

If you are considering a major efficiency retrofit in your building, tune it up first. A comparison between operating costs for new and old equipment is only a fair one if the old equipment is operating as well as it can. A tune-up will help you make a better decision. You may identify new retrofit ideas during the tune-up. Alternatively, the tune-up may save so much energy that the retrofit (and its capital cost) may be deferred.

Durability of Equipment and Building Structure

Tuning up your building will save money because HVAC and other equipment that is maintained regularly lasts longer. Even more important, following the building envelope tune-up procedures in this manual will help make the building last longer by limiting the amount of air and moisture penetration into the building envelope system.

Fire and Life Safety

Leaky high-rise buildings allow more uncontrolled airflow throughout the building. This increased airflow becomes a problem during a fire. Controlling this airflow by following the envelope sealing procedures in this manual will potentially slow the spread of fire and smoke.

The damage to the structure and building cladding system caused by excessive air and moisture escaping through the building envelope is also a safety issue. The resulting damage to the wall components can cause pieces of the cladding system to fall off posing a risk to people below.

Improved Occupant Comfort

Tune-ups to the building's envelope and HVAC systems will improve your ability to control temperature and humidity in the building. This will reduce the staff time required to address occupant complaints. Even more significantly, occupants who are more satisfied with building comfort will tend to stay longer, reducing the cost of turnovers.

Better Health for Occupants

A properly tuned-up building, with better control over airflow, temperature, and humidity, will help to ensure healthy indoor environments and better occupant health. If the relative humidity is below or above the 40-60 per cent range for long periods of time, airborne bacteria, viruses, and fungi will all tend to become more prevalent. Properly operated ventilation systems will control humidity and provide fresh air needed to maintain a healthy indoor environment.

Uncontrolled leakage can permit exhaust fumes to enter the building from the garage or through air intakes near the ground floor. The tiny particles and other contaminants in car exhaust irritate the lungs and can be particularly dangerous to asthmatics and others with impaired breathing. Tuning up the building envelope will help prevent these fumes and particulates from entering the building.

Environmental Citizenship

Tuning up combustion appliances in the building will reduce energy use and the related emission of pollutants. Lower electrical consumption will reduce pollutant emissions at the power plants that generate the electricity. Lower water use reduces the impact of water treatment and wastewater treatment on the local environment and conserves a valuable resource.

Owner Commitment

Regular building tune-ups and maintenance show your commitment to the building. Occupants tend to respond positively to this commitment and become more willing to help take care of the building. The result is happy occupants, less complaints and reduced turnover rates.

1.3 The Tune-up Sequence

A building is a system as all of its components and systems interact and work together. Nearly every part of it is involved at some level in the tune-up process. The tune-up procedures in this manual have been placed in a logical sequence, based on the science of building systems. When tuning up your building, it is suggested that you follow the sequence shown below:

1. **Building envelope.** Tuning up the envelope will reduce the load on the heating and cooling system, and will make it easier for the building's ventilation system to direct air where it is most needed. It will also improve occupant comfort and improve the durability of the building envelope system. The envelope section of this manual provides guidance on the order in which to tune-up different parts of the envelope.
2. **Heating and Air Conditioning Systems.** Once uncontrolled heat loss through the building envelope has been reduced through the building envelope tune-up measures, work can begin to optimize the performance of the space heating system. Heating in most Canadian MURBs accounts for close to 50 per cent of annual energy use. Start with the primary heating source, such as a central boiler (if there is one), and work out to where the heat is delivered to the suites. While air conditioning systems do not consume as much energy as space heating systems, they can cause significant electricity demand charges during the summer months.
3. **Ventilation Systems.** Tune-up ventilation systems next, because of their importance to comfort and air quality and their impact on energy consumption due to fan energy use and tempering (and sometimes cooling) of the ventilation air.
4. **Domestic hot water.** Domestic hot water uses significantly more energy in MURBs than in most other large buildings. Reducing hot water consumption saves both energy and water.
5. **Lighting and appliances.** Tune-up lighting and appliances next, to use electricity more efficiently and reduce internal loads on the cooling system (or overheating in non air-conditioned buildings).
6. **Other systems.** The other systems covered in this manual include swimming pools and in-suite plumbing.

2.1 Building Envelope Systems

This section explains how to tune up the "envelope" of your building.

High-rise MURBs typically have one of the following types of envelope systems:

- Steel stud walls with either brick veneer, metal siding, or stucco finish
- Masonry block construction with brick veneer
- Pre-cast concrete/curtain wall construction
- Masonry block or brick

Regardless of the type of cladding system, all systems can benefit from measures designed to limit air penetration into the cladding from the interior, and exterior, of the building. The following table lists the procedures needed to tune up the envelope of your building and the focus is on air sealing. The procedures are more effective if done in the order shown in the table below.

Procedure		System Types
En-1	Seal the bottom of the building	All types
En-2	Seal the top of the building	All types
En-3	Seal outside walls and openings	All types
En-4	Seal vertical shafts	All types
En-5	Compartmentalize service areas	All types

2.1 Why is Envelope Sealing so Important?

Fresh air is necessary to the occupants of a building, and the ventilation system, or operable windows, are designed to supply it. Uncontrolled air leakage through the exterior building envelope is therefore undesirable as it is not needed for ventilation, it causes draft and comfort problems, it can cause moisture problems in the exterior cladding and interior finishes, and, adds to the heating bill. In buildings that are not well sealed, air leakage and interior air movement caused by "wind effect" and "stack effect" can overpower ventilation systems causing indoor air quality problems.

What is Wind Effect?

When wind pushes on a building, it tends to create a high air pressure zone on the side of the building it hits and a low air pressure zone on the other side of the building. This causes outdoor air to leak into the building on the side of the building the wind hits and then travel across the interior of the building to the opposite side where it leaks back out of the building. Such air movement is a problem as apartments on the up wind side of the building can be drafty while apartments on the opposite side of the building receive air transferred from other apartments and common areas. This air movement also causes heat loss and adds to the heating bill.

What is Stack Effect?

A heated building in winter acts like a chimney. Warm air enters through holes and cracks on the ground floor, rises through vertical shafts and stairwells, and exits through holes and cracks near the top. The cold air sucked into suites on the lower floor often causes those occupants to complain of cold drafts.

The air forced out through the building skin at the top carries moisture and heat with it. This can damage wall finishes, windows, insulation, and exterior siding systems. Occupants on upper floors may sometimes complain about over-heating and odour transfer problems while occupants on the lower floor tend to complain about drafts.

Starting the building tune-up with the envelope makes sense, because:

- The load on the heating and cooling system will be reduced, saving energy and money.
- The reduced load provides more opportunities to tune the heating, ventilating, and cooling equipment.
- The ventilation system will work better, providing fresh air to the occupants more effectively.
- Humidity will be easier to control, reducing condensation and dangerous mold and mildew growth while improving comfort.
- Overall indoor air quality can be improved making the occupants more comfortable.
- The building will last longer, because less moisture will be carried into the wall and roof structures.

Finding Air Leakage

When assessing the condition of seals, weatherstripping, gaps and joints, it is useful to use smoke puffers (also called air current detectors). These devices are available from mechanical suppliers and other agencies specializing in building diagnostic instruments. These inexpensive tools can be used by on-site staff to locate air leakage locations and to provide an indication of the severity of the leakage.

The best time to look for air leakage is when it is cold and windy outside. Such conditions cause leakage to be more noticeable. Air leakage testing can also be done in combination with blower doors. Blower doors are devices used to depressurize rooms which forces leakage through cracks, gaps and holes. Smaller depressurization test rigs are used to test window air leakage. Blower door and window testing is available, as a service, from building envelope engineering firms.

NOTE:

Ensure air sealing products installed in fire-rated wall, ceiling and floor assemblies are approved for use in such applications.

Procedure En-1: Seal the Bottom of the Building

Description

Seal building envelope leakage points at the bottom of the building.

Benefits

As part of an overall envelope sealing project, this procedure offers the following benefits:

- energy efficiency;
- comfort;
- durability;
- health;
- safety.

This procedure also helps isolate the parking garage from the rest of the building, preventing exhaust fumes from getting into the building and suites above.

Implementation

When sealing the building envelope, the bottom of the building is nearly as important to seal as the top. The taller the building, the greater the potential is for stack effect. This phenomenon causes air to be pulled in near the bottom of the building, to move up inside the building through vertical shafts and stairwells, and then to be expelled near the top. Sealing the bottom of the building will block many of the air leakage locations.

Tune-ups to seal the bottom of the building include:

Weatherstrip Access Doors to Underground Parking

1. If your building has underground parking, locate all access doors between the parking garage and the building, including those on each side of a parking garage vestibule or elevator lobby.
2. Check condition of weather-stripping around doors. If necessary, continue as indicated in the following steps.
3. Install high quality polyethylene-clad foam compression seal onto the doorstop.
4. Install single metal holder and fin-and-pile door sweep on exterior and interior faces of the door.
5. Seal around door closer and lock with a polyethylene-clad v-shaped foam gasket on the edge of the stop (not the face).
6. Caulk front edge of both metal holders—for compression gasket and fin-and-pile door sweep

Weatherstrip Exhaust and Air Intake Vents

7. Exhaust and intake vents are often located in various ground floor locations such as laundry rooms, workshops, washrooms, etc.
8. Use one-component polyurethane foam sealant to seal gap between vent and wall.
9. Check linkage of louvres and lubricate and adjust to ensure they close and seal properly.
10. Check louvres; repair or replace damaged items.
11. Re-weatherstrip louvres where necessary with closed cell neoprene foam gaskets.

Seal Soffits

12. Soffits at the bottom of the building are found in locations such as above exterior exit and entry doors and where upper occupied floors jut out over the ground floor. Air can leak into the soffit area and then into the adjacent building floor areas.
13. **Option 1:** Install vertical dry-wall bulkhead from top of first floor exterior wall to the floor slab above.
14. Seal penetrations, such as conduit, trusses, pipes, and ducts that penetrate the newly installed bulkhead. Use one- or two-component polyurethane foam sealant.
15. **Option 2 (if Option#1 is impractical):** Seal exterior perimeter of soffits using one- or two-component polyurethane foam sealant. Seal around electrical fixtures and other penetrations in the soffit
16. Box any recessed light fixtures with drywall, ensuring all joints are sealed effectively.

Weatherstrip All Ground Floor Exterior Access Doors

17. **Steel Doors:** Install high quality polyethylene-clad foam compression seal onto the doorstop.
18. Install single metal holder and fin-and-pile door sweep on exterior and interior faces of the door.
19. Seal around door closer and lock with a polyethylene-clad v-shaped foam gasket on the edge of the stop (not the face). On double steel doors, install this gasket on the flange between the two doors.
20. Caulk front edge of both metal holders—for compression gasket and fin-and-pile door sweep.
21. Single Commercial Doors: Install fin-and-pile type product to replace existing material that in many cases consists of cotton pile.
22. Double Commercial Doors: Replace pile in channel between doors with upgraded

fin-and-pile product or use a fin-and-pile door bottom seal/weather-stripping sweep on the face of each door so that the fins overlap.

Seal Pipe, Duct, Cable and Other Service Penetrations into Core of the Building from the Exterior (Including Unsealed Areas such as Parking Garages and Loading Bays)

23. Depending on gap size, either:
    a. Install fire-rated caulking material (for smaller openings), or
    b. Inject one- or two-component polyurethane foam sealant as an air seal and backing, with a fire-rated mortar product to obtain required fire rating and smoke seal.

Seal Sprinkler Hanger Penetrations and Other Holes

24. Install fire-rated caulking material or plaster compound to seal the sprinkler pipe to surround ceiling finish.

Weatherstrip Inspection Hatches

25. Inspection hatches are sometimes located in dropped ceilings of underground parking below occupied parts of building.
26. Install closed cell neoprene foam tape around perimeter of the frame against which the hatch closes.
27. Install siliconized latex caulk to seal perimeter of frame to the drywall ceiling.

Seal Walls Between Parking Garage and Core of Building

28. Gaps and cracks may exist where walls separating underground parking garage areas from the core of the building. The walls may be penetrated by ducts, wiring and pipes.
29. Depending on gap size between the partition wall and floor or ceiling or around ducts, wiring and pipes, either:
    a. Install fire-rated caulking, or
    b. Install one-component polyurethane foam sealant as a backing for fire-stop mortar.

Cautions

- This procedure will tighten your building. Ensure that the building is properly ventilated. Refer to Section 4 for information on tuning up the ventilation system.
- Carefully follow instructions for the handling and use of air sealing products.
- Be careful to follow procedures for ensuring personal safety when working around electrical equipment.
- Wear protective clothing, footwear, eye protection, and a helmet when appropriate.
- Ensure air sealing products installed in fire-rated wall, ceiling and floor assemblies are approved for use in such applications.

Where to Turn

Some of these tasks can be done by building staff. If you have concerns about safety or knowledge of how to carry out the work correctly, hire an air leakage control contractor to do the work.

Procedure En-2: Seal the Top of the Building

Description

Seal building envelope leakage points at the top of the building.

Benefits

As part of an overall envelope sealing project, this procedure offers the following benefits:

- energy efficiency;
- comfort;
- durability;
- health;
- safety.

Implementation

Note: air sealing many details can be relatively complicated. Additionally, the quantity of air sealing required can make the work imposing for on-site staff. Consider retaining a contractor who specializes in air sealing buildings (sometimes called "weatherization" or "air leakage control" contractors). Some of the following tune-ups can be done by on-site staff while others should be done by air leakage control contractors. The following list of air leakage control tune-up provides guidance where leaks are located and how they can be sealed.

When sealing the building envelope, consider the top of the building as one of the most important area to seal. The taller the building, the greater the potential is for stack effect. During the heating season, this phenomenon causes air to be pulled in near the bottom of the building, to move up inside the building through vertical shafts and stairwells, and then to be expelled near the top. Sealing the top of the building will block many of the air leakage locations.

Tune-ups to seal the top of the building include the following tasks:

Seal Roof/Wall Intersections

1. Where possible, access the ceiling or roof space on top floor of building. This is usually only possible in mechanical penthouses or in rooftop amenity rooms with removable suspended ceilings.
2. Seal the wall to roof joint using two-component polyurethane foam.

If the roof is steel-decked:

3. Inject two-component polyurethane foam sealant between the flutes of steel decking and the top of the wall.
4. Drill flutes as near as possible to outside walls and inject foam into cavities in order to create continuity between the walls and the roof deck.

Weatherstrip Doors to Mechanical Penthouse and Roof

5. If there is a mechanical penthouse on the roof, assess the condition of the weatherstripping on the exterior and interior doors by seeing how firmly the doors close against the weatherstripping. If you can see light, or feel air movement around the door, or the weatherstripping is visibly damaged, it should be replaced.
6. Install high quality polyethylene foam compression seal onto the doorstop.
7. Install single metal holder and fin-and-pile door sweep on exterior and interior faces of the lower edge of the door.
8. Seal around door closer and lock with a polyethylene-clad v-shaped foam gasket on the edge of the stop (not the face).
9. Caulk front edge of both metal holders—for compression gasket and fin-and-pile door sweep.

10. Ensure the door frame is sealed (typically with caulking) to the surrounding wall.

Seal Penthouse Ceiling/Wall and Floor/Wall Intersections

11. If the penthouse has block walls, do nothing unless cracks to outside are evident—in which case the cracks can be sealed with caulking.
12. If the penthouse has metal siding, seal edges of flange to the floor and roof with caulking or one-component polyurethane foam sealant (depending on size of crack).

Seal HVAC and Other Equipment Penetrations

13. For each piece of equipment on the roof, remove hood or housing from the roof curb to expose mechanical ducting.
14. Use one-component polyurethane foam sealant to seal any gaps between ducting and curb. Backing material may be required to support the foam as it cures.
15. Check linkage of air intake and exhaust louvres and lubricate and adjust to ensure they close tightly.
16. Check louvres; repair or replace damaged items.
17. Re-weatherstrip louvres where necessary with closed cell neoprene foam gaskets.
18. Re-weatherstrip garbage chute vent caps and gasket the operable top hatch.
19. Re-weatherstrip stairwell smoke vent/roof access hatches.

Cautions

- These procedures will reduce air leakage in your building. Ensure that the building is still properly ventilated. Refer to Section 4 for information on tuning up the ventilation system.
- Carefully follow instructions for the handling and use of air sealing products.
- Be careful to follow procedures for ensuring personal safety when working on roofs or around electrical equipment.
- Wear protective clothing, footwear, eye protection, and a helmet when appropriate.
- Ensure air sealing products installed in fire-rated wall, ceiling and floor assemblies are approved for use in such applications.

Where to Turn

Some of these tasks can be done by building staff. If you have concerns about safety or knowledge of how to carry out the work correctly, hire an air leakage control contractor to do the work.

Procedure En-3: Seal Exterior Walls and Openings

Description

Seal leakage points in exterior walls. Most of these leakage points are in the suites themselves, including windows, window-wall joint, balcony doors, exhaust vents, sleeves of packaged terminal air conditioners (PTACs) or air-conditioners, and other penetrations.

Benefits

As part of an overall envelope sealing project, this procedure offers the following benefits:

- energy efficiency;
- comfort;
- durability;
- health;
- safety.

Implementation

Procedures En-1 through En-3 will help to reduce uncontrolled infiltration into, and air movement through, the building due to stack effect. The next task is to improve the airtightness of outside walls, primarily in the suites. This will further improve energy efficiency, but perhaps more importantly will directly improve the occupants' comfort. Apartment or condominium turnovers are a good time to implement these measures as some of the measures can otherwise be disruptive for the occupants.

To seal the outside walls and openings, follow these steps:

Weatherstrip All Windows, Doors, Balcony and Patio Doors

1. **Windows and Patio Doors:** Replace existing pile product located in T-slots around the perimeter of the door and operable windows with upgraded fin-and-pile product.
2. **Standard Doors:** Install high quality polyethylene-clad foam compression seal onto the doorstop.
3. Install single metal holder and fin-and-pile door sweep on exterior and interior faces of the door.
4. Seal around door closer and lock with a polyethylene-clad v-shaped foam gasket on the edge of the stop (not the face).
5. Caulk front edge of both metal holders—for compression gasket and fin-and-pile door sweep.
6. Seal door frame to surrounding wall with paintable, siliconized latex caulk.

Seal Window Trim

7. Seal window trim to surrounding wall using clear, paintable, siliconized latex caulk.
8. Seal trim to window returns and then seal the window returns to window frame.

Seal around Exhaust Fans and Ducting

9. In the bathroom, remove exhaust fan grilles.
10. Seal between ducting or fan housings and drywall (interior) and masonry (exterior), using one-component polyurethane foam sealant or clear paintable siliconized latex caulk. Seal any hole in the exhaust fan housing or exhaust duct with mastic or aluminum foil-type tape.

Seal All Service Penetrations

11. Seal pipes in bathrooms and kitchens, where they pass through walls, ceilings, or floors, with either one-component polyurethane foam sealant (for holes) or silicone caulk (for cracks). Remember to check in cabinets for pipe penetrations through adjacent walls or floors to other apartments.

Seal and Insulate Behind Baseboard Heaters

12. *Ensure Power to the heater units is OFF.* For maximum safety, turn off power to the baseboard heaters at the electrical panel.
13. Unfasten baseboard heater from wall.
14. Clean up any dirt, dust, grease and remove debris.
15. Seal any wall penetrations (for electrical service) and gap between drywall and floor with one-component polyurethane foam sealant (or caulk depending on size of gap).

Seal PTAC and Air-conditioner Sleeves

16. Ensure that the air-conditioner is leveled according to manufacturer's directions before starting. This is necessary to ensure proper condensate drainage.
17. Ensure that any drainpipes are kept clear. Condensate drains should project at least 2.5 cm (1 inch) from the exterior wall face of the building.
18. Add rigid insulation to the flat part of the air-conditioner sleeve that is parallel to the wall of the building. The amount added will depend on the flat surface available and available clearances.
19. Apply an exterior covering (ideally pre-finished metal) to the insulation.
20. Seal all joints and sleeves (inside and outside) with one-component polyurethane foam sealant or clear paintable siliconized latex caulk between unit and sleeve, and between sleeve and wall.

Seal Electrical Receptacles

21. *Ensure power to the receptacles* is *OFF.* Turn off power at the electrical panel.
22. Remove existing receptacle plate.
23. Install clear siliconized latex caulk at perimeter of receptacle.
24. Install CSA approved foam receptacle gaskets onto caulk.
25. Replace plate.
26. Insert childproof safeties, with gasket knockout pushed onto the prongs, into unused receptacles.

Seal Wall and Floor Juntion

28. Remove baseboard.
29. Seal gap between drywall and floor with one-component polyurethane foam sealant.
30. Replace baseboard using silicone caulk as adhesive.

31 It may be possible to seal the baseboard to the floor if it cannot be removed.

Cautions

- This procedure will tighten your building. Ensure that the building is properly ventilated. Refer to Section 4 for information on tuning up the ventilation system.

- Carefully follow instructions for the handling and use of air sealing products.
- Be careful to follow procedures for ensuring personal safety when working around electrical equipment.
- Wear protective clothing, footwear, eye protection, and a helmet when appropriate.
- Ensure air sealing products installed in fire-rated wall, ceiling and floor assemblies are approved for use in such applications.

Where to Turn

Some of these tasks can be done by building staff. If you have concerns about safety or knowledge of how to carry out the work correctly, hire an air leakage control contractor to do the work.

Procedure En-4: Seal Vertical Shafts

Description

Seal leakage points between vertical shafts such as plumbing, electrical, HVAC risers, garbage chutes, elevators and the rest of the building.

Benefits

As part of an overall envelope sealing project, this procedure offers the following benefits:

- energy efficiency;
- comfort;
- durability;
- health;
- safety.

Implementation

After the top and bottom of the building, sealing vertical shafts (stairwell, elevator shafts, plumbing and electrical chases, ventilation risers, etc) is the next priority. The taller the building, the greater the potential is for stack effect. This phenomenon causes air to be pulled in near the bottom of the building, to move up inside the building through vertical shafts and stairwells, and then to be expelled near the top. Sealing the shafts blocks the main pathways for this air.

To seal the shafts, follow these steps:

Weatherstrip Fire Doors in Stairwell

1. Install high quality polyethylene-clad foam compression seal onto the doorstop.
2. Install single metal holder and fin-and-pile door sweep on exterior and interior faces of door.
3. Seal around door closer and lock with a polyethylene-clad v-shaped foam gasket on the edge of the stop (not the face).

4. Caulk front edge of both metal holders – for compression gasket and fin-and-pile door sweep.

Seal Around Fire Hose Cabinets

5. Seal water pipe penetrations into the cabinet using one-component polyurethane foam sealant.
6. Install siliconized latex caulk to seal frame of the cabinet to wall and to seal cabinet joints.

Seal Plumbing, Electrical, Cable and Other Wall, Floor, and Ceiling Penetrations within Service Rooms

7. Seal around pipes, wires, ducts using one- or two-component polyurethane foam sealant as a backing for fire-stop mortar. (System must comply with ULC/ULI rated assemblies).

Reduce Size of Cable Holes into Elevator Machine Room

8. Reduce gap between the elevator cables and wiring and the adjacent floor area to maximum 1/2 inch around cables.
9. Use sheet metal to reduce clearance between the floor slab and cables.
10. Fasten the sheet metal to the floor slab using screws. Then caulk perimeter to floor.

Seal Bus Bar Openings

11. Seal perimeter using one- or two-component polyurethane foam sealant plus fire-stop mortar.

Seal Garbage Chute Perimeter and Access Hatches

12. In the garbage chute access rooms on each floor, install closed cell neoprene foam tape around the hatch opening to seal garbage chute hatch to the surrounding chute housing.
13. Use siliconized latex caulk to seal chute housing perimeter to wall.

Seal Corridor Ventilation Grille Perimeters

14. Remove grille.
15. Seal any gap between ducting and wall with fire-rated caulk.

Seal Smoke Shaft Access Doors

16. Install closed cell neoprene tape on the doorstop of any smoke shaft access doors.

Seal All Accessible Service Shafts

17. Where services pass through floor/ceiling slabs, use one- or two-component polyurethane foam sealant as backing for fire-stop mortar.

Cautions

- This procedure will reduce air movement through your building. Ensure that the building is properly ventilated. Refer to Section 4 for information on tuning up the ventilation system.
- Carefully follow instructions for the handling and use of air sealing products.
- Be careful to follow procedures for ensuring personal safety when working around electrical equipment.
- Wear protective clothing, footwear, eye protection, and a helmet when appropriate.
- Ensure air sealing products installed in fire-rated wall, ceiling and floor assemblies are approved for use in such applications.

Where to Turn

Some of these tasks can be done by building staff. If you have concerns about safety or knowledge of how to carry out the work correctly, hire an air leakage control contractor to do the work.

Procedure En-5: Compartmentalize Service Areas

Description

Seal doors and penetrations between service rooms or other separate areas and the rest of the building.

Benefits

As part of an overall envelope sealing project, this procedure offers the following benefits:

- energy efficiency;
- comfort;
- durability;
- health;
- safety.

Implementation

Many of the service rooms in the building do not need to be kept at as comfortable a temperature as the suites and common areas. In some cases they may also have more openings to the outside. While the openings to the outside will have been sealed as part of procedure En-3, sealing the openings to the rest of the building will further reduce the infiltration. Other unique spaces, such as indoor swimming pools, need to be isolated from other areas (compartmentalized) so that their different temperature and humidity conditions can be maintained more easily and kept out of the rest of the building.

If your building has the following types of spaces, it is important to compartmentalize them:

- vented mechanical rooms;
- garbage compactor rooms;
- emergency generator rooms;
- high voltage rooms;
- shipping docks;
- elevator rooms;
- workshops;
- garage vestibules or airlocks;
- indoor pools;
- other rooms with temperature and humidity requirements different from the building's main living spaces.

To compartmentalize each of these spaces, follow these steps:

Weatherstrip All Steel Access Doors Into the Building Interior

1. Install high quality polyethylene-clad foam compression seal onto the door stop.
2. Install single metal holder and fin-and-pile door sweep on exterior and interior faces.
3. Seal around door closer and lock with a polyethylene-clad v-shaped foam gasket on the edge of the stop (not the face).
4. Caulk front edge of both metal holders—for compression gasket and fin-and-pile door sweep.

Seal All Wall, Ceiling and Floor Penetrations (Pipes, Cables, Ducts) Into the Room

5. Seal using one- or two-component polyurethane foam sealant as a backing for fire-stop mortar to give appropriate fire rating and smoke seal.
6. If cracks exist, seal wall to floor and wall to ceiling joints.

Cautions

- This procedure will tighten your building and has the capacity to greatly reduce the air change rate of the room. Ensure adequate mechanical ventilation is installed and is operating. Refer to Section 4 for information on tuning up the ventilation system.
- Carefully follow instructions for the handling and use of air sealing products.
- Be careful to follow procedures for ensuring personal safety when working around electrical equipment.
- Wear protective clothing, footwear, eye protection, and a helmet when appropriate.
- Ensure air sealing products installed in fire-rated wall, ceiling and floor assemblies are approved for use in such applications.

Where to Turn

Some of these tasks can be done by building staff. If you have concerns about safety or knowledge of how to carry out the work correctly, hire an air leakage control contractor to do the work.

3. Heating and Cooling Systems

This section explains how to tune up the heating and cooling systems in your building.

Many MURBs in Canada are heated with baseboard systems, with electric baseboard somewhat more common than hydronic baseboard. If the suites are air-conditioned, it is most often done by window air conditioners, packaged terminal air conditioners (PTACs) or fan-coil systems. In this section, ***electric*** baseboard, with or without window air conditioners, is referred to as system **HC Type A**. ***Hydronic*** baseboard, with or without window air conditioners, is referred to as system **HC Type B**.

Other systems that are sometimes found include:

- Two- or four-pipe fan coil systems (**HC Type C**)
- Packaged air-conditioning equipment (**HC Type D**)
- Split systems (**HC Type E**)
- Packaged terminal air-conditioners (**HC Type F**)
- Gas or electric furnaces (**HC Type G**)
- Heat pumps (**HC Type H**)

The following table identifies procedures that will help you make your operation more efficient.

Procedure		System Types
HC-1	Tuning up an Electric Baseboard System	HC Type A
HC-2	Tuning up Hydronic Baseboards	HC Type B
HC-3	Boiler Tune-up	HC Types B and C
HC-4	Tuning up a Fan-coil Unit	HC Type C
HC-5	Chiller Tune-up	HC Type C
HC-6	Condenser Tune-up	HC Type C
HC-7	Cooling Tower Tune-up	HC Type C
HC-8	Tuning up a Unit Heater	All types with garages
HC-9	Tuning up a Packaged Air-Conditioning Unit	HC Type D
HC-10	Tuning up a PTAC	HC Type F

3.1 Why Tune Up the Heating and Air Conditioning Systems?

In the average MURB, about half the energy is used for heating. Therefore, it is good practice to ensure that heating and cooling systems are running as efficiently as possible. Heating and air conditioning system tune-ups can provide energy savings up to 10 per cent.

Procedure HC-1: Tuning up an Electric Baseboard Heater

Electric Baseboard Heaters

An electric baseboard heater provides perimeter heating. Each heater consists of a metal-sheathed electric heating element enclosed in a cabinet. The units are less than 6 in. in depth and are installed along the bottom of walls. A major portion of the heat is transferred to the room by convection. Air enters the enclosure below the heating element, heats up as it passes through the element, and leaves the enclosure through the outlet grill. Baseboard units are controlled by wall-mount or integral thermostats.

Description of Tune-up

The specific tasks include cleaning the heating element and tuning up the thermostat.

Benefits

- Reduced electricity consumption, utility cost and greenhouse gas emissions
- Improved space comfort conditions
- Reduced occupant complaints due to "burnt dust" smell on start-up.

Implementation

Checks and Tune-ups

1. *Ensure Power to the Units is OFF.* For maximum safety, turn off power to the baseboard heaters at the electrical panel. If this is not possible, turn the thermostat down to its lowest setting before starting work.
2. *Clean the Heating Element.* When heat exchanger surfaces become dirty or damaged the heat transfer rate is lowered. To clean the heating element, remove the enclosure and vacuum the element with the dusting or extender attachments of a vacuum. Before replacing the enclosure, visually inspect the element. If it is damaged, have it replaced.
3. *Sealing Behind Baseboards.* The area behind baseboard heaters, where the service wires come out of the wall, is often a source of building envelope leakage. Consult procedure En-3 for further information.
4. *Check the Thermostat.* Check each thermostat to ensure that it is functioning properly and, if it is a wall unit, that it is suitably located away from any direct source of heat (i.e., direct sunlight from a nearby window). The thermostat should "click" when turned up (with the power turned on at the electrical panel), and the baseboard heater should heat up.
5. *Calibrate the Thermostat.* Older thermostats often lose their ability to maintain steady room temperature, causing occupants to adjust them upwards. This results in increased space heating costs. Check the thermostat calibration by comparing the temperature it displays with the room temperature measured with a handheld thermometer. Adjust or replace it if out by 0.5°C.

6. *Reset Thermostat Set Point.* Adjust the thermostat setting to lowest acceptable level. Consult the occupants to establish their preference. MURBs with electric baseboard heat often have individual metering of heating energy by suite. Occupants in those buildings are usually willing to keep thermostats set low, because they will see the savings on their heating bills. Thermostats should not be set so low that window condensation becomes a problem during the winter months.

Cautions

- Regular visual inspections should be conducted to ensure efficient system operation.
- Be careful not to damage the element when cleaning it.
- Check to ensure baseboards are not covered by furniture, drapes, etc., that could reduce heating capacity or be a fire hazard.

Where to Turn

Use in-house staff or incorporate in your maintenance service contract. Baseboards should be tuned up when suites are turned over.

Procedure HC-2: Tuning up a Hydronic Baseboard Heater

What is a Hydronic Baseboard Heater?

A hydronic baseboard heater provides perimeter heating in a MURB building. Each heater consists of a long finned-tube heating element mounted in a metal enclosure and is installed along the bottom of a wall. A major portion of the heat is transferred to the room by convection. Air enters the enclosure below the heating element, heats up as it passes through the element, and leaves the enclosure through the outlet grill. A thermostat mounted either on the wall or on the inlet pipe normally regulates the flow of hot water to the unit. Manual dampers in the enclosure, if they are present, can be used to reduce heat output (by reducing airflow through the baseboard) by up to 80 per cent.

Description of Tune-up

The task includes cleaning the heating coil, tuning up the thermostat, and adjusting the damper.

Benefits

- Reduced fuel consumption, utility cost and greenhouse gas emissions
- Increased unit capacity
- Improved space comfort conditions, reduced complaints.

Implementation

Checks and Tune-ups

1. *Clean and Comb the Coil.* When heat exchanger surfaces become dirty or damaged the heat transfer rate is reduced. Water temperature will then have to be set higher to compensate. To clean the heat exchange surfaces, remove the enclosure and carefully vacuum the coil with the dusting or extender attachments of the vacuum. Use a coil brush to loosen dust from the coil before vacuuming. If the coil has fins, use a fin comb to clean between the fins and straighten bent fins to normal position. Before replacing the enclosure, visually inspect the coil. If it is damaged, have it repaired or replaced.
2. *Sealing Behind Baseboards*. The area behind baseboard heaters, where the hot water pipes come through the wall or floor, is often a source of building envelope leakage. Consult procedure EN-3 for further information.
3. *Check the Thermostat.* Check each thermostat to ensure that it is functioning properly and, if it is wall-mounted, that it is suitably located away from any direct source of heat (i.e., direct sunlight from a nearby window). Check pipe-mounted thermostats for leaks.
4. *Calibrate the Thermostat.* Older thermostats often lose their ability to maintain steady room temperature, causing occupants to adjust them upwards. This results in increased space heating costs. Check the thermostat calibration by comparing the temperature it displays with the room temperature measured with a handheld thermometer. Adjust or replace it if the difference is greater than 0.5°C.
5. *Reset Thermostat Set Point.* Adjust the thermostat setting to lowest acceptable level. Consult the occupants to establish their preferences and solicit their help.
6. *Adjust the Manual Damper.* Adjust the manual damper to ensure proper airflow over the fin tube. If there are complaints of overheating, the damper can be adjusted to reduce airflow through the baseboard. If there are complaints regarding cold rooms, try to more fully open the damper.

Cautions

- Regular visual inspections should be conducted to check the conditions for efficient system operation.
- Be careful not to damage the coil or fins when cleaning them.
- Check to ensure baseboards are not covered by furniture, drapes, etc., that could reduce heating capacity or be a fire hazard.

Where to Turn

Use in-house staff or incorporate in maintenance service contract.

Baseboards should be tuned up when suites are turned over.

Procedure HC-3: Boiler System Tune-up

Description

Perform boiler efficiency checks, flue gas analysis, and tune-up adjustments at least annually to ensure peak operating efficiency and performance. Depending on the boiler type, optimum efficiencies often range between 75 to 80 per cent, but can fall to 50 per cent or less without regular servicing and tune-ups.

Most of the following tune-ups that involve burners, controls, heat exchangers and venting systems should be done by a qualified contractor. Such tune-ups are described to familiarize property owners, manager and custodial staff with the opportunities to improve heating system performance.

Benefits

- Reduced fuel consumption, utility cost and greenhouse gas emissions
- Increased boiler capacity
- Longer equipment service life and consequently deferred capital replacement cost
- Increased operating reliability and less long term maintenance costs
- Improved space comfort conditions, less complaints.

Implementation

Buildings with centralized fuel-fired hot water systems will typically have multiple natural draft boilers equipped with on-off or high-low-off burner controls. Larger facilities are often heated with forced-draft boilers equipped with modulating burner controls. Boiler system efficiency can be improved by tuning up the boiler itself, optimizing the control system, and tuning up the heat distribution system.

Boiler service should be undertaken by a qualified tradesperson. Unless building staff are experienced with maintaining this type of equipment, they should be cautious about undertaking even routine maintenance. It is worthwhile to have the boiler contractor provide a "tour" of the equipment during a maintenance visit, to train staff on tasks they should do in between visits.

Tuning up a boiler will normally involve the following necessary steps to ensure optimum efficiency and performance:

Boiler Efficiency Checks

Most of these checks require the expertise of a trained technician.

1. *Check Fresh Air Supply.* Air openings to the boiler room from outside must be kept wide open and free of restrictions to air flow. Sufficient fresh air supply is necessary to ensure optimum combustion and efficiency. Clean air intake grilles. Ensure proper operation of motorized louvers.
2. *Check Flue Gas Venting.* Check that the vent has no obstructions and is in good condition. Proper venting is essential to ensure efficient combustion. Insufficient draft or overdraft caused inefficient fuel combustion. Obstructed, or partially obstructed vents represent a safety hazard.
3. *Check Water Treatment.* Check to ensure that the proper water treatment process is being used to minimize scale build-up and corrosion in the boiler. Keep a water treatment logbook to confirm contractors are performing tests and adding treatment as required. Continuous requirements for water treatment chemicals can indicate a water leakage problem in the system.

4. *Check Burner Condition.* Dirty burners or burner orifices will cause the boiler output rate and thermal efficiency to decrease.

5. *Check Heat Transfer Surfaces.* Internal and external build-up of soot and scale on the heating surfaces creates an insulating effect that reduces heat transfer efficiency.

6. *Combustion Analysis.* Perform a flue gas analysis at high and low fire. The following information is typically obtained and recorded in order to determine boiler combustion efficiency: flue gas temperature and concentrations of O_2, CO, CO_2, inlet fuel pressure, draft pressure, and water temperatures entering and leaving the boiler.

Boiler Efficiency Tune-ups

Almost all of tasks 7 through 16 should be undertaken by a qualified contractor. The information is provided to assist building staff in supervising the project.

7. *Tune-ups:* As part of routine maintenance, or if the combustion efficiency determined by the flue gas analysis is less than the boiler manufacturer's recommendation, then have the following corrective actions taken to improve combustion and heat transfer efficiency:

   i. Clean the burners.

   ii. Clean the fire-side of the heat exchanger.

   iii. De-scale the water-side of the heat exchanger.

   iv. For natural draft gas-fired boilers, adjust the draft and/or fuel pressure in the manifold. For oil-fired boiler, check for proper oil pump operation.

   v. For forced draft boilers, adjust the fuel/air ratio.

   vi. Ensure the combustion air grille is clean and that dampers (if installed) are operational and have gaskets in good condition. Clean and lubricate the damper actuator (if installed).

Control System Optimization

8. *Reset Boiler Temperature.* Adjust the controls to automatically reset the operating temperature of the boiler. The building load varies with outside temperature, so controls should correctly adjust the boiler operating temperature as a function of outdoor temperature. This will improve boiler efficiency and reduce standby losses.

9. *Adjust Boiler Operating Controls.* Adjust the differential between the temperature at which the boiler turns on and the temperature at which it turns off to between 3°C and 6 °C. In addition, the set-points of multiple boiler installations should be sequenced by 3 to 6 °C. This will reduce short cycling and improve the seasonal efficiency of the boilers.

Heating Distribution System

10. *Repair Worn or Damaged Insulation:* Worn or damaged boiler and pipe insulation should be repaired or replaced to reduce heat loss.

11. *Tune up Heating Water Circulation Pump:* Refer to procedure DHW-4 for further information.

12. *Turn Down Thermostats:* Thermostats located in common areas, storage rooms, garages, etc. should be lowered to reduce space heating requirements.

13. *Install Programmable Thermostats:* Programmable thermostats can be used in apartment suites, offices, retail, and common rooms to reduce space heating requirements at night and during unoccupied periods.

14. *Water balance:* Hydronic distribution systems are balanced when they are new, to ensure adequate hot water is distributed to different parts of the building. The testing, adjusting, and balancing (TAB) contractor does this by setting balancing valves throughout the building so that each zone receives the right amount of heat. If the building is now experiencing over-heated and/or under-heated areas, consider having the balancing redone.

15. *Lime Build-up:* Lime build-up inside the distribution piping can restrict hot water flow. Replace this piping as soon as possible.

Short Cycling Boilers

You may find that your boilers fire repeatedly for very short periods. This is called short cycling. This not only uses more energy, but also wears the equipment out faster. Boiler controls always have a differential between the temperature at which the boiler turns on and the temperature at which it turns off. If this is adjustable, it should be set to at least 3°C (5°F) and preferably 6°C (10°F).

If you have multiple boilers, they should not all have the same firing set points. The temperature set points should be at least 3°C (5°F) and preferably 6°C (10°F) apart.

If in doubt about how to undertake this procedure, consult your boiler service company or a controls contractor.

Cautions

- **Boiler service work should be carried out by a trained technician**
- Regular visual inspections should be conducted to check the conditions for efficient boiler operation. Ask your boiler technician to show you how to carry out these inspections.
- Boiler manufacturer's instructions must be followed if the tune-ups result in low operating temperature (<60°C [140°F]) or frequent cold starts. These concerns are related to the potential for condensation of flue gases or thermal shock to the boiler.
- Significant pipe insulation work should be done by a qualified contractor. Always review provincial building regulations regarding fire safety before applying insulation materials. Be aware of damaged or worn pipe insulation containing asbestos insulation. If you are unsure, consult an insulation contractor or asbestos remediation expert.
- For work conducted in the top floor ceiling or mechanical penthouses, pipe riser shafts should also be sealed to prevent air movement up the shafts and out of the building (see section 2 for further information).

Where to Turn

Boilers should be serviced by a qualified tradesperson. Look under Boiler Service in the phone book.

Procedure HC-4: Tuning up a Hydronic Fan-coil Unit

What is a Fan-coil Unit?

A fan-coil unit is a heating and cooling unit found in apartment suites, entrances and vestibules. Its basic elements are a finned-tube coil, air filter, and fan-motor section. The fan circulates air from the space through the coil that contains either hot water or chilled water for heating and cooling respectively. Fan-coil units are usually controlled by coil water flow, fan speed, or a combination of these. Horizontal fan-coils are typically located on the ceiling of a utility room in the apartment. Vertical fan-coil units are typically located near or along the exterior walls and are enclosed in drywall partitions.

Description of Tune-up

Tune-up fan-coil systems involve adjusting the controls and verifying proper component control in each mode of operation. Check the control and operation of the thermostat, valves, fan, filter, duct insulation, coil and ventilation damper (if applicable) and note any problems.

Benefits

- Reduced fuel consumption, utility cost and greenhouse gas emissions
- Increased unit capacity
- Longer equipment service life and consequently deferred capital replacement cost
- Increased operating reliability and less long term maintenance costs
- Improved space comfort conditions
- Improved indoor air quality

Implementation

Fan-coil Checks and Tune-ups

1. *Ensure Power to the Unit is OFF.* For maximum safety, shut off the power to the unit at the electrical panel.
2. *Check and Adjust Motor Drive.* Check to ensure that the motor and fan are properly aligned and adjusted. Improper alignment can cause an increase in motor energy consumption and cause damage to the drive. For direct drive sets, the fan should rotate freely when spun. For belt drive units, ensure belts are tight and not worn.

3. *Lubrication.* Lubrication of components, such as couplings, shaft bearings, and supports must be maintained with proper lubricants and at intervals recommended by the manufacturer. Follow manufacturer's instruction.

4. *Motor Lubrication.* Motors in these units are often permanently lubricated and do not require further service. If the motor in your unit requires lubrication, it will be at much longer intervals than the fan itself—not more than once every five years. These motors will generally be oil-lubricated. Follow the manufacturer's instructions to keep the oil reservoir filled with the right grade and type of oil. Do not mix different kinds of oils.

5. *Fan Cleaning.* Fans should be vacuumed periodically to maintain their efficiency. Dust build-up on blades and housing interior causes higher static pressure loss in the fan and consequently lower efficiency.

6. *Check for Fan Noise and Vibration.* Fan noise and vibration can be caused by one or more factors:

   - fan wheel out of balance;
   - worn or damaged bearings;
   - insufficient or worn isolators;
   - poor alignment;
   - corrosion.

   Corrective repairs and adjustments will improve fan efficiency.

7. *Replace Dirty Air Filters.* Air filters should be cleaned or replaced at regular intervals according to manufacturer's recommendations. Dirty air filters restrict airflow, and consequently, reduced heating and cooling capacity and performance, and increase fan-coil energy consumption.

8. *Clean and Comb the Coil.* When heat exchanger surfaces become dirty or damaged the heat transfer rate is reduced. To clean the heat exchange surfaces, access the coils and carefully vacuum the coil with the dusting or extender attachments of the vacuum. Use a coil brush to loosen dust from the coil before vacuuming. If the coil has fins, use a fin comb to clean between the fins and straighten bent fins to normal position. Be cautious about straightening fins, as they can be fragile. Before replacing the enclosure, visually inspect the coil. If it is damaged or leaking, have it repaired or replaced.

9. *Check condensate pan.* Chilled water coils will have a condensate pan under them with a connected drain. Ensure condensation pans located under chilled water coils are clean, properly sloped to drain properly and the drain pipes are clear. Pour 1 litre of water into the pan to check for proper slope and drainage.

10. *Check duct insulation.* Inspect any duct lining that may be present inside the fan-coil or in the supply air plenum leading from, or the return air plenum leading to, the fan-coil. Duct lining can become damaged and deteriorated over time and become an indoor air quality concern. Duct lining should be removed and replaced by a qualified contractor.

11. *Check for duct leaks.* Gaps and loose joints in forced air systems should be sealed with mastic-type duct sealant.

12. *Check position of dampers and grilles.* Ensure that in-duct dampers or dampers located behind grilles and louvres are properly positioned to provide air flow to, and from, the rooms served as required.

13. *Clean grilles and louvers:* Vacuum dust and dirt off the vanes of the grilles and louvers.

Control System Optimization

14. *Adjust Unit Controls Adjust the fan-coil unit controls to optimize system operation.*

    - Check the thermostat to ensure that it is functioning properly and it is located away from any direct source of heat (i.e., direct sunshine)
    - Older thermostats often lose their ability to maintain steady room temperature. Check the thermostat calibration by comparing the temperature it displays with the room temperature measured with a handheld thermometer. Adjust or replace the thermostat if the difference is greater than 0.5°C.
    - The fan speed control (if applicable) should always be adjusted to the minimum necessary to meet the load requirements. For most units, the low-speed setting is sufficient for most days. Show the occupants how to use the control and enlist their help in ensuring that the lowest speed setting is used whenever possible.
    - Check and adjust the ventilation control (if applicable) to provide the necessary outdoor air as required by occupancy.

Cautions

- Maintenance personnel have the capability to perform system checks, filter changes and basic troubleshooting. Advanced motor diagnostics, controls work, hydronic repairs and insulation-related work requires qualified contractors.
- Regular visual inspections should be conducted to check the conditions for efficient system operation.
- Shut off unit before servicing. For maximum safety, shut off the power at the electrical panel.

Where to Turn

Use in-house staff or incorporate in maintenance service contract with a qualified mechanical contractor.

Procedure HC-5: Tuning up an Air Conditioning Chiller

What is an Air Conditioning Chiller?

Large central air conditioning chillers can have centrifugal or reciprocating compressors and typically have cooling capacities of more than 500 kW (150 tons of cooling). These units usually supply chilled water at 7°C (45 °F) to fan-coils and unit ventilators throughout an apartment building to cool these spaces. While the chillers can have an air-cooled condenser, the majority of large central chillers are water-cooled through a cooling tower.

Description of Tune-up

Performing routine maintenance checks and tune-up adjustments on a regular basis can result in energy savings, trouble-free operation and longer equipment life. The routine maintenance checks and tune-up adjustments should include the chiller, cooling tower, chilled water piping and controls.

Chiller service should be undertaken by a qualified tradesperson. Consult the "Where to Turn" section of this procedure. Unless building staff are experienced with maintaining this type of equipment, they should be cautious about undertaking even routine maintenance. It is worthwhile to have the chiller contractor provide a "tour" of the equipment during a maintenance visit, to train staff on tasks they should do in between visits.

Weekly routine maintenance checks and recording of operating conditions are suggested below.

Information on possible tune-ups is presented to make building staff aware of the opportunities available to improve system performance.

Benefits

- Reduced electricity consumption and greenhouse gas emissions
- Increased unit capacity
- Longer equipment service life and consequently deferred capital replacement cost
- Increased operating reliability and less long term maintenance costs
- Improved space comfort conditions

Implementation

Chiller Checks and Tune-ups

1. *Maintain a log or record of the Chiller Operation*
   A log of the chiller's operating pressures and temperatures taken at least twice weekly provides a means for detecting variations in system performance. Recording of the following information is suggested:
   - refrigerant suction pressure;
   - refrigerant discharge pressure;
   - chilled water supply temperature;
   - chilled water return temperature.

   Changes in the recorded pressures and temperatures can signal problems with decreased efficiency due to:
   - scaling or dirt accumulation in the condenser or the evaporator;
   - low water flow rate from clogged strainers or faulty pump operation;
   - refrigerant leaks.

   Modest changes in pressures and temperatures may also occur due to varying load on the chiller. A trained technician will be able to interpret the log and identify problems.

2. *Check oil level in reciprocating chillers.* The compressor oil level should be checked weekly. With the compressor running, the oil should be visible in the sight glass. Low oil levels can cause premature wear of the piston rings and shorten the compressor life.
3. *Check refrigerant level in reciprocating chillers.* The refrigerant level should be checked weekly. With the compressor running, the flow of refrigerant is observed in the liquid line sight glass. No gas bubbles should be present. The presence of gas bubbles can indicate a low refrigerant level. Low refrigerant level will reduce the capacity and efficiency of the chiller and increase the energy consumption. It may also indicate a leak in the refrigerant system.
4. *Check purge compressor oil level in centrifugal chillers.* The purge compressor oil level should be checked monthly by viewing the oil level through the crankcase sight glass. With the compressor idle, the oil level in the crankcase sight glass should appear at the center of the glass.
5. *Check for presence of water condensate in centrifugal chillers.* The purge drum sight glass should be inspected weekly for evidence of water condensate. The water condensate appears in the sight glass as a separate liquid floating on the surface of the liquid refrigerant.

Tune-ups

These tasks should be done by qualified contractors. The information below is provided to assist building staff in supervising the work.

6. *Evaporator and Condenser Cleaning.* At the end of the cooling season, the evaporators and condensers should be inspected for dirt accumulation or scale formation. Dirty surfaces reduce the heat transfer efficiency increasing pressures and energy consumption.
7. *Reset Chilled Water Temperature.* Typical chilled water temperatures of 7°C (45°F) are only needed during peak summer periods. Adjust the chilled water temperature as a function of the cooling load. During mild weather, 2 to 4 ° higher chilled water temperatures can be sufficient to satisfy the air conditioning load.
8. *Reset Condenser Water Temperature.* Typical entering condenser water temperature of 29 °C (85 °F) are only needed during peak summer periods. During mild weather at lower outside air temperatures, condenser water temperatures can be set lower by up to 3 °C (6 °F) which will help reject more compressor heat. The compressor does not need to work as hard resulting in increased efficiency and energy savings. **The chiller manufacturer should be consulted to determine the safe lowest entering condenser water temperature.**

Cautions

- Chiller preventive maintenance work should be carried-out by a trained refrigeration technician.
- Regular visual inspections should be conducted to check the conditions for efficient system operation
- Chiller manufacturer recommendations should be followed if the tune-ups result in low entering condenser water temperatures (<75 °F) for centrifugal chillers. These concerns are related to potential internal lubrication problems.

Where to Turn

Chillers should be serviced by qualified contractors (e.g., refrigeration technicians). This includes the equipment start-up, mid-season operational inspection, equipment shutdown at the end of the season and the comprehensive annual inspection.

Procedure HC-6: Condenser Tune-up

What is a Condenser?

Large central air conditioning systems normally reject the heat through air-cooled or water-cooled condensers. Air-cooled condensers use outside air as the cooling medium. Fans draw air past the refrigerant coil to condense the refrigerant. Air-cooled condensers have very low maintenance requirements due to their simplicity.

Description of Maintenance Requirements

Maintenance of air-cooled condensers is typically only required at the beginning of the season plus one or two operational inspections to ensure that the fans are operating properly.

Condenser service should be undertaken by a qualified tradesperson. Consult the "Where to Turn" section of this procedure. Unless building staff are experienced with maintaining this type of equipment, they should be cautious about undertaking even routine maintenance. It is worthwhile to have the condenser contractor provide a "tour" of the equipment during a maintenance visit, to train staff on tasks they should do in between visits.

Information on possible tune-ups is presented to make building staff aware of the opportunities available to improve system performance.

Benefits

- Reduced electricity consumption and greenhouse gas emissions
- Increased unit capacity
- Longer equipment service life and consequently deferred capital replacement cost
- Increased operating reliability and less long term maintenance costs
- Improved space comfort conditions

Implementation

Condenser Checks and Tune-ups

1. *Keep Heat Transfer Surfaces Clean.* At the beginning of the season clean all debris from air inlet louvers. Fouling of the coil surfaces reduces the heat transfer efficiency and increases the air conditioning energy consumption.
2. *Condenser Coil Cleaning.* At the beginning of the season, wash the coil with a mild detergent and cleaner, using a pressure washer. In order to avoid bending the fins, washing should be done in a parallel motion to the fins.
3. *Condenser Fan Motor.* At the beginning of the season inspect the fan motor for unusual noises and vibration.

Cautions

- Air-cooled condensers have very low maintenance requirements, but it is still important to ensure that the coils are clean, and fans are in proper operating condition.

Where to Turn

Air-cooled condensers should be serviced by a qualified contractor at the beginning of the season. The service should include the verification of fan controls, and the condition of the coil.

Building maintenance staff can carry out some of the visual inspection and cleaning.

Procedure HC-7: Tuning up a Cooling Tower

What is a Cooling Tower?

Large central air conditioning systems normally reject the heat through air-cooled or water-cooled condensers. Cooling towers cool the condenser water by spraying it at the top of the cooling tower. The water is cooled by air as it drops into a catch basin. Some cooling towers also include fill media, such as splash bars or vertical sheets of plastic film, to increase the heat transfer. The basic elements of a cooling tower are:

- the catch-basin or sump where the water collects;
- spray nozzles;
- fill used to increase the water surface area;
- tower fans;
- pumps;
- controls.

The controls include a three-way control valve to maintain a fixed-return water temperature, temperature sensors controls and relays to control and stage the tower fans.

Water treatment of the condenser water is required to control algae growth in the sump and scale building. Similarly, periodic blowdown (forced drainage) is required to remove minerals and chemicals which tend to concentrate in the water.

Description of Tune-up

Performing routine maintenance checks and tune-up adjustments on a regular basis can result in energy savings, trouble-free operation and longer equipment life. The routine maintenance checks and tune-up adjustments should include the cooling tower, condenser water piping and controls.

Cooling tower service should be undertaken by a qualified tradesperson. Consult the "Where to Turn" section of this procedure. Unless building staff are experienced with maintaining this type of equipment, they should be cautious about undertaking even routine maintenance. It is worthwhile to have the cooling tower contractor provide a "tour" of the equipment during a maintenance visit, to train staff on tasks they should do in between visits.

Weekly routine maintenance checks are suggested below.

Information on possible tune-ups is presented to make building staff aware of the opportunities available to improve system performance.

Benefits

- Reduced electricity consumption and greenhouse gas emissions
- Increased unit capacity
- Longer equipment service life and consequently deferred capital replacement cost
- Increased operating reliability and less long term maintenance costs
- Improved space comfort conditions

Implementation

Cooling Tower Checks and Tune-ups

1. *Maintain a log or record of the Cooling Tower Operation.* A log of the condenser water operating temperatures taken at least twice weekly provides a means for detecting variations in the cooling tower performance. Recording of the following information is suggested:
   - supply condenser water temperature;
   - return condenser water temperature.
2. *Check Water Distribution and Flow Rate.* A properly functioning cooling tower is designed to reject the heat from the compressor. Reduced water flow can decrease the heat rejection capacity of the tower and increase the air conditioning energy consumption. Visually check that distribution nozzles are clean and provide an even water spray. Also check that the water level in the catch basin is not too high or too low. The tower manufacturer should be contacted to determine the design water level. A low level accompanied by high condenser water return temperatures could suggest a reduced water flow.
3. *Check Air Flow Rate.* Reduced airflow rate can also reduce the heat rejection capacity. To ensure proper airflow, the fan and drive systems including belts must be checked. In belt drive systems check the belt for proper tension and tighten if required.
4. *Check Water Treatment and Bleed-off Rate.* Water quality in a cooling tower is maintained by a combination of water treatment and bleed-off. Bleed-off is manual or automatic removal of a portion of the water in the tower, to be replaced by clean water. Improper treatment or bleed-off rate will affect the water quality promoting corrosion, scale build-up and algae formation. These conditions will reduce the heat rejection capacity by clogging spray nozzles and fill. In addition, corrosion will shorten the life of the cooling tower. Inspect the tower basin, spray nozzles and fill materials monthly for evidence of algae growth, as well as evidence of corrosion. Increase the bleed-off rate to keep the concentration of impurities at acceptable levels. A bleed rate of 1 per cent of water flow is typically adequate to maintain acceptable water quality. The need for higher bleed-off rates could indicate a problem with water treatment feed and controls.
5. *Other Operational Checks.* Additional operational inspections that should be carried out include:
   - inspect the catch basin float assembly;
   - verify that the overflow drain is clear.
6. *Reset Condenser Water Temperature.* Typical entering condenser water temperature of 29 °C (85 °F) are only needed during peak summer periods. During mild weather at lower outside air temperatures, condenser water temperatures can be reset lower by up to 3 °C (6 °F) which will help reject more compressor heat. The compressor does not need to work as hard resulting in increased efficiency and energy savings. **The chiller manufacturer should be consulted to determine the safe lowest entering condenser water temperature.**

Cautions

- Cooling tower preventive maintenance work should be carried-out by a qualified contractor.
- Chiller manufacturer recommendations must be followed if the tune-ups result in low entering condenser water temperatures (below 24 °C or 75 °F) for centrifugal chillers. These concerns are related to potential internal lubrication problems.

Where to Turn

Cooling towers should be serviced by a qualified contractor. Building maintenance staff can carry out weekly operational checks and maintain a log.

Procedure HC-8: Tuning up a Unit Heater

What is a Unit Heater?

A unit heater comprises a fan and motor, a heating element, and an enclosure. Its principal function is to heat the space it is located in. It is available in a variety of configurations and may utilize steam, hot water, electricity, oil or gas as the heating source. The types most commonly found in MURBs are horizontal-blow propeller fan units equipped with a hot water or electric heating coil. The units are typically found in spaces where noise levels and high air motion are not a principal concern such as garages and storage rooms. A room thermostat is typically used to start and stop the fan motor based on demand.

Description of Tune-up

Regular inspection and maintenance of unit heaters assures maximum operational performance, energy efficiency, and longer equipment life. The heating element, fan blades and housing should be cleaned when necessary by brushing or blowing with high-pressure air. The motor, fan bearings and drive should be lubricated and maintained according to manufacturer's recommendations.

Benefits

- Reduced fuel consumption, utility cost and greenhouse gas emissions
- Increased unit capacity
- Longer equipment service life and consequently deferred capital replacement cost
- Increased operating reliability and less long term maintenance costs

Implementation

Unit Heater Checks and Tune-ups

Be sure the unit heater is switched off—preferably at the electrical service breaker.

1. *Check Motor Drive and Coupling.* The motor drive and coupling should be periodically checked for wear and alignment, and adjustments made as required. Improper alignment can cause an increase in motor energy consumption and cause damage to the drive.
2. *Lubrication.* Lubrication of components, such as couplings and shaft bearings must be maintained with proper lubricants and at intervals recommended by the manufacturer. Following this procedure will ensure maximum efficiency of the operation.
3. *Motor Lubrication.* The amount of attention required by the various motors used with unit heaters varies greatly. The instructions for lubrication must be followed carefully to ensure trouble-free operation. Excess lubrication, or the use of an improper lubricant could cause the motor to fail.
4. *Fan Cleaning.* Fans should be cleaned periodically with a brush or compressed air. Dirt on the blades and housing reduces the capacity and may unbalance the blades, which could cause noise and bearing damage.
5. *Check for Fan Noise and Vibration.* Fan noise and vibration can be caused by one or more factors:
   - fan out of balance;
   - worn or damaged bearings;
   - poor alignment;
   - dirt or corrosion build-up.

   Corrective repairs, cleaning and adjustments will improve fan efficiency.
6. *Clean and Comb the Coil.* When heat exchanger surfaces become dirty or damaged, the heat transfer rate is reduced. To clean the heat exchange surfaces, remove the enclosure and brush or blow with high-pressure air. A fin comb can be used to clean between the fins and straighten bent fins to normal position. Before replacing the enclosure, visually inspect the coil. If it is damaged, have it repaired or replaced.

Control Optimization

7. *Adjust Unit Controls.* Adjust the fan-coil unit controls to optimize system operation.
   - Check the thermostat to ensure that it properly activates and, more importantly, deactivates the unit heater, and that it is suitably located away from any direct source of heat.
   - Older thermostats often lose their ability to maintain steady room temperature, causing occupants to adjust them upwards. This results in increased space heating costs. Check the thermostat calibration by comparing the temperature it displays with the room temperature measured with a handheld thermometer. Adjust or replace the difference in temperatures is greater than 0.5°C.
   - Unit heaters are often used in indoor garages or service rooms. Thermostats in these spaces should typically be set no higher than 15°C.

Cautions

- Do not undertake tune-up or maintenance tasks unless you are confident you know how to do the work. It is well worthwhile to have an HVAC contractor provide an equipment tour to building staff during a maintenance visit, to train the staff on how to perform routine tasks in between visits.
- Electrical power to the unit heater should be disconnected before inspecting or tuning. For maximum safety, disconnect the power at the electrical panel.

Where to Turn

Use in-house staff or incorporate in maintenance service contract.

Procedure HC-9: Tuning up a Room Air Conditioner

Description of Tune-up

Performing routine maintenance procedures on a room air conditioner can result in improved system performance, energy savings, and longer equipment life. Room air conditioners are typically through-wall or through-window packaged units. To identify any maintenance concerns, conduct a functional test of the unit's system performance. To do this, adjust the controls and verify proper control in each mode of operation check for any deficiencies or maintenance concerns.

Benefits

- Reduced fuel consumption, utility cost and greenhouse gas emissions
- Increased unit capacity
- Longer equipment service life and consequently deferred capital replacement cost
- Increased operating reliability and less long term maintenance costs
- Improved space comfort conditions

Implementation

Room Air Conditioner Checks and Tune-ups

1. *Seal Air Conditioner Sleeve.* Procedure En-3 provides details on how to weatherize the sleeve around the air conditioner.
2. *Check Fan Motor Coupling.* Check to ensure that the motor and fans are properly aligned and adjusted. Improper alignment can cause an increase in motor energy consumption and cause damage to the drive.

3. *Fan Lubrication.* Lubrication of fan-drive components such as couplings, shaft bearings, and supports must be maintained with proper lubricants, using the intervals and procedure recommended by the manufacturer. Following this procedure will ensure maximum efficiency of operation.

4. *Motor Lubrication.* Motors in these units are often permanently lubricated. If the motor in your unit requires lubrication, it will be at much longer intervals than the fan itself—not more than once every five years. These motors will generally be oil-lubricated. Follow the manufacturer's instructions to keep the oil reservoir filled with the right grade and type of oil. Do not mix different kinds of oils.

5. *Clean Fans and Louvers.* Fans and air louvers should be cleaned periodically to maintain system efficiency. Dust build-up on fan blades and louvers decreases airflow, increases energy consumption, and lowers the unit's cooling capacity.

6. *Check for Fan Noise and Vibration.* Fan noise and vibration can be caused by one or more factors:

   - fan wheel out of balance;
   - worn or damaged bearings;
   - poor alignment.

   Corrective repairs and adjustments will improve fan efficiency.

7. *Replace Dirty Filters.* Air filters should be cleaned or replaced at regular intervals according to manufacturer's recommendations. Loaded air filters result in a restriction of airflow, and consequently, reduced capacity and performance, and an increase in fan energy consumption.

8. *Clean and Comb the Coils.* When the evaporator and condenser coils become clogged the efficiency of the refrigeration cycle is reduced. To clean the heat exchange surfaces, remove the enclosure and vacuum the coils with the dusting or extender attachments of the vacuum. Use a coil brush to loosen dust from the coil before vacuuming. A fin comb can be used to clean between the fins and straighten bent fins to normal position. Be cautious about straightening fins, as they can be fragile. Before replacing the enclosure, visually inspect the coil. If it is damaged or leaking, have it repaired or replaced.

9. *Check Condensate Drain Pan.* A condensate drain pan is located under the cooling coils to catch and drain condensate (water that drips from the cooling coils). If the air conditioner is not properly installed, condensate may not drain properly and could spill and damage surrounding surfaces and finishes. Check to see that the drain pan is clean, dry and is draining properly. Check to see if the drain from the drain pan is clear and properly terminated in a drain. Sometimes it may be necessary to clear the drain, clean the pan, and adjust the air conditioner so the pan drains properly.

Control Optimization

10. *Adjust the Unit Controls to Optimize System Efficiency.*

    - Turn the unit off when the space is unoccupied.
    - Increase the space set point to the higher acceptable level during occupied periods.

- Older thermostats often lose their ability to maintain steady room temperature, causing occupants to adjust them upwards. This results in increased space heating costs. Check the thermostat calibration by comparing the temperature it displays with the room temperature measured with a handheld thermometer. Adjust or replace it if the temperature difference is greater than 0.5°C.
- Check and adjust the fan speed control (if applicable) to the minimum necessary to meet the load requirements.
- Adjust the louvers to direct the flow of air in the desired direction.
- Check and adjust the ventilation control (if applicable) to provide the necessary outdoor air as required by occupancy.

Cautions

- Electrical power to the air conditioner must be disconnected before inspecting or tuning. If the unit is plugged into a wall socket, simply unplug it. If not, for maximum safety, disconnect power to the unit at the electrical panel.
- Be aware of any warranty on the units. If a warranty is in place, it may be necessary to have any servicing done by the vendor or an approved contractor.

Where to Turn

Use in-house staff or incorporate in maintenance service contract.

Procedure HC-10: Tuning up a PTAC

What is a PTAC?

A Packaged Terminal Air Conditioner (PTAC) is a through-the-wall room air conditioner. The unit incorporates a complete air-cooled refrigeration and air-handling package in an individual package. It includes refrigeration components, outdoor louver, blower fan, electric or hot water heating coil, controls and provision for outdoor air ventilation. Cooled or warmed air is discharged in response to thermostatic control to meet room requirements.

Description of Tune-up

Performing routine maintenance procedures on PTACs can result in improved system performance, energy savings, and longer equipment life. To identify any maintenance concerns, conduct a functional test of PTAC system performance. To do this, adjust the controls and verify proper component control in each mode of operation. Check the control and operation of each component in each mode of operation and note any deficiencies.

Benefits

- Reduced fuel consumption, utility cost and greenhouse gas emissions
- Increased unit capacity
- Longer equipment service life and consequently deferred capital replacement cost
- Increased operating reliability and less long term maintenance costs
- Improved space comfort conditions

Implementation

PTAC Checks and Tune-ups

1. *Seal PTAC Sleeve.* Procedure En-3 provides details on how to weatherize the sleeve around the PTAC unit.
2. *Check and Adjust Fan Motor Drive.* Check to ensure that the motor and fan are properly aligned and adjusted. Improper alignment can cause an increase in motor energy consumption and cause damage to the drive.
3. *Lubrication.* Lubrication of components, such as couplings, shaft bearings, and supports must be maintained using the proper lubricants, intervals and procedures recommended by the manufacturer. Following this procedure will ensure maximum efficiency of operation.
4. *Motor Lubrication.* Motors in these units are often permanently lubricated. If the motor in your unit requires lubrication, it will be at much longer intervals than the fan itself—not more than once every five years. These motors will generally be oil-lubricated. Follow the manufacturer's instructions to keep the oil reservoir filled with the right grade and type of oil. Do not mix different kinds of oils.
5. *Clean Fans and Louvers.* Fans and air louvers should be cleaned periodically to maintain system efficiency. Dust build-up on fan blades and louvers decreases airflow, increases energy consumption, and reduces the unit's heating and/or cooling capacity.
6. *Check for Fan Noise and Vibration.* Fan noise and vibration can be caused by one or more factors:
   - fan wheel out of balance;
   - worn or damaged bearings;
   - poor alignment.

   Corrective repairs and adjustments will improve fan efficiency.
7. *Replace Dirty Air Filters.* Air filters should be cleaned or replaced at regular intervals according to manufacturer's recommendations. Loaded air filters result in a restriction of airflow, and consequently, reduced capacity and performance, and an increase in fan energy consumption.
8. *Clean and Comb the Coils.* When the evaporator and condenser coils become clogged, the efficiency of the refrigeration cycle is reduced. To clean the heat exchange surfaces, remove the enclosure and vacuum the coils with the dusting or extender attachments of the vacuum. Use a coil brush to loosen dust from the coil before vacuuming. A fin comb can be used to clean between the fins and straighten bent fins to normal position. Be cautious about straightening fins, as they can be fragile. Before replacing the enclosure, visually inspect the coil. If it is damaged or leaking, have it repaired or replaced.
9. *Check Condensate Drain Pan:* A condensate drain pan is located under the cooling coils to catch and drain condensate (water that drips from the cooling coils). If the air conditioner is not properly installed, condensate may not drain properly and could spill and damage surrounding surfaces and finishes. Check to see that the drain pan is clean, dry and is draining properly. Check to see if the drain from the drain pan is clear and properly terminated in a drain. Sometimes it may be necessary to clear the drain, clean the pan, and adjust the air conditioner so the pan drains properly.

Control System Optimization

10. *Adjust the Fan-coil Unit Controls to Optimize System Operation.*

    - Check the thermostat to ensure that it correctly activates and deactivates the unit. Unless it is mounted on the unit itself, ensure that it is suitably located away from any direct source of heat (i.e., direct sunshine).
    - Older thermostats often lose their ability to maintain steady room temperature, causing occupants to adjust them upwards. This results in increased space heating costs. Check the thermostat calibration by comparing the temperature it displays with the room temperature measured with a handheld thermometer. Adjust or replace it if the temperature difference is greater than 0.5°C.
    - Adjust the thermostat set-point to meet the heating or cooling requirements of the space.
    - Check and adjust the fan speed control (if applicable) to the minimum necessary to meet the load requirements.
    - Check and adjust the ventilation control (if applicable) to provide the necessary outdoor air as required by occupancy.

Cautions

- Electrical power to the unit heater must be disconnected before inspecting or tuning. For maximum safety disconnect power to the unit at the electrical panel.
- Be aware of any warranty on the units. If a warranty is in place, it may be necessary to have any servicing done by the vendor or an approved contractor.

Where to Turn

Use in-house staff or incorporate in maintenance service contract.

4. Ventilation Systems

This section explains how to tune up the ventilation system in your building.

Most MURBs in Canada have corridor ventilation systems to provide the buildings with fresh air and to make up air vented by kitchen and bathroom exhaust fans. The kitchens and bathrooms in MURBs are ventilated by central exhaust systems (exhaust risers served by rooftop exhaust fans) or in-suite exhaust systems (bathroom fans and kitchen range hoods that are vented through the exterior wall of the apartment). Corridor ventilation systems with central exhaust are referred to in this section as system **Vent Type A**. Corridor ventilation systems with in-suite exhaust are referred to as **Vent Type B**. Some apartments are ventilated by packaged heat recovery ventilators but this is not a common approach.

If your building has an enclosed, indoor garage, it must be ventilated. In some buildings, there is exhaust ventilation in the garages, with no heating of the make-up air. Other garages have make-up air units with gas-fired or electric heating.

Ventilation systems may also provide fresh air to pressurize parking garage vestibules, and to exhaust service and mechanical rooms and common laundry rooms.

The following table will help you choose the tune-up procedures that will help make your building's ventilation systems more efficient:

Procedure		System Types
V-1	Tuning up a Corridor Ventilation System	Vent Types A and B
V-2	Tuning up a Heat Recovery Ventilator	Vent Types A and B
V-3	Tuning up Exhaust Systems	Vent Type A and B

4.1 Why Tune-up the Ventilation System?

Both the corridor air system and the exhaust system help to ventilate your building. In a typical high-rise building, the corridor ventilation system supplies air to the corridors and common areas. Therefore, it is important to ensure that the systems are well-maintained to help ensure good indoor air quality.

The operation of corridor ventilation and kitchen/bathroom exhaust systems also consumes a significant amount of heating—both to move the air and to heat (and sometimes air condition) incoming ventilation air. It is therefore very important to ensure efficient operation to help minimize energy consumption and operating costs.

Procedure V-1: Tuning up a Corridor Ventilation System

What is a Corridor Ventilation System?

Corridor ventilation systems deliver air to the corridors on each floor. In a typical MURB, a central rooftop unit supplies outdoor air to the corridor. A corridor ventilation unit typically consists of the following elements: outdoor air intake louvre (often motorized to allow the duct system to be closed when it is not in operation), filter, heating section, supply fan-motor set, vertical ducting, fire dampers at each floor or behind each diffuser, and supply air diffusers (with integral flow control damper). The heating section is most commonly an indirect gas-fired burner, electric resistance coil, or hydronic heating coil. A unit is typically continuously operated or set to operate on a fixed schedule via a time-clock or building automation system. The corridor air system provides a continuous amount of air at a constant temperature to the corridors.

Description of Tune-up

Regular inspection and maintenance of corridor ventilation system assures maximum operational performance, energy efficiency, and longer equipment life. Tune-up procedures such as adjusting controls, changing filters, lubricating bearings, and cleaning fan blades and heat transfer surfaces should be carried out according to manufacturer's recommendations.

Tune-ups involving burners, heat exchangers, controls and venting systems should be done by a qualified contractor. In such cases information on possible tune-ups is presented to make building staff aware of the opportunities available to improve system performance.

Benefits

- Reduced fuel consumption, utility cost and greenhouse gas emissions
- Increased unit capacity
- Longer equipment service life and consequently deferred capital replacement cost
- Increased operating reliability and less long term maintenance costs
- Improved air quality conditions in corridor areas and other zones served

Implementation

Seal Roof Penetrations and Intake Louvres

Refer to procedure En-2 for further information on sealing HVAC equipment penetrations and louvres.

Fan System Checks and Tune-ups

1. *Check Fan and Motor Alignment.* Check and adjust the alignment of the fan drive sheaves. Improper alignment is detected by excessive vibration and noise, and can cause excessive power requirements and damage to belts.
2. *Check Fan Belt Tension and Condition.* Loose and worn belts can cause slipping, squealing, and rapid wear therefore belts should be tensioned and replaced according to manufacturer's recommendations.
3. *Lubrication.* Lubrication of components such as couplings, shaft bearings, linkages and supports must be maintained with proper lubricants and at intervals recommended by the manufacturer. Following this procedure will ensure maximum efficiency of the operation.
4. *Motor Lubrication.* The manufacturer's instructions for lubrication must be followed carefully to ensure trouble-free operation. Excess lubrication, or the use of an improper lubricant could cause the motor to fail.
5. *Fan Cleaning.* Fans should be cleaned periodically with a brush or compressed air. Dirt on the blades and housing interior reduces airflow and causes the fan to use more energy.
6. *Check for Fan Noise and Vibration.* Fan noise and vibration can be caused by one or more factors:
   - fan wheel out of balance;
   - worn or damaged bearings;
   - poor alignment;
   - insufficient isolation;
   - dirt or corrosion build-up.

   Corrective repairs, cleaning and adjustments will improve fan efficiency.

7. *Replace Dirty Filters.* Air filters should be cleaned or replaced at regular intervals according to manufacturer's recommendations. Dirty air filters result in a restriction of airflow, reduced performance and an increase in fan energy consumption.

8. *Check for Air Leaks.* Airflow and energy is lost when air leaks from unsealed openings and connections. Check the condition of the following for evidence of leakage and seal as required:

   - fan cabinet casing;
   - door gaskets;
   - access doors close tightly—supply new gaskets if needed;
   - flexible ducting connectors between fan housing and adjacent ducting—check for cracks/holes in flex connnectors and patch or replace;
   - Duct joints—use mastic type duct sealant.

9. *Check the Outdoor Air Damper.* Check that the damper strokes fully open and closed without binding and closes tightly. Adjust the linkage and lubricate to ensure proper operation. Check the condition of the blade seals. Check the condition of the seal between the damper frame and the wall.

Heating Section Checks and Tune-ups

If the unit has an electric or hydronic heating coil then:

10. *Check Coils are Clean, Fins are in Good Condition.* When heat exchanger surfaces become dirty or damaged the heat transfer rate is reduced. Clean the coil with high-pressure air or a brush. A fin comb can be used to clean between the fins and straighten bent fins to normal position. Be cautious about straightening fins, as they can be fragile. Before replacing the enclosure, visually inspect the coil. If it is damaged or leaking, have it repaired or replaced.

If the unit has a gas-fired burner then have a qualified contractor conduct the following gas-fired burner checks and tune-ups:

11. *Check Fresh Air Supply.* Air openings must be kept wide open and free of restrictions to flow. Sufficient fresh air supply is necessary to ensure optimum combustion and efficiency.

12. *Check Flue Gas Venting.* Check that the vent has no obstructions and is in good condition. Proper venting is essential to ensure efficient combustion. Insufficient draft or overdraft can cause safety hazards and inefficient burning.

13. *Check Burner Condition.* Dirty burners or burner orifices will cause the output rate and thermal efficiency to decrease.

14. *Check Heat Transfer Surfaces.* Internal and external build-up of soot on the heating surfaces creates an insulating effect that reduces heat transfer efficiency.

15. *Combustion Analysis.* Perform a flue gas analysis at high and low fire and record combustion efficiency.

16. *Tune-ups:* As part of routine maintenance by the maintenance contractor, or if the combustion efficiency determined by the flue gas analysis is less than the manufacturer's recommendation, the following corrective actions will improve combustion and heat transfer efficiency.

    i. Clean the burners.

    ii. Clean the heat exchanger.

    iii. Adjust the draft and/or fuel pressure in the manifold.

Distribution System Checks and Tune-ups

17. *Check for Duct Restrictions:* Check the ductwork distribution system for duct restrictions such as closed, or partially closed, dampers and closed fire dampers. Adjust dampers. Open fire dampers as required.

18. *Check Air Balance:* Check that the air supplied to each floor and each diffuser is relatively the same. Balancing dampers are usually located behind corridor air diffusers. Approximate adjustments can be made using rough comparisons of airflow from floor to floor. More precise adjustment using measured airflow will require the services of an air balance contractor.

19. *Check Ducts for Dust Build-up.* Where accessible, inspect the inside of the supply ducts for cleanliness. If access panels are small, use a flashlight and mirror to visually inspect for dust and dirt build up. If ducts are dirty, have them professionally cleaned.

20. *Clean Grilles and Diffusers.* Use a vacuum, brush or warm-water solution to clean dirt and dust from outdoor air grilles and louvers and supply air diffusers on each floor.

Control Optimization

21. *Reduce Supply Air Temperature.* Adjust the controls to reduce the temperature of the air supplied to the corridors. Do not adjust below 18 °C.

22. *Minimize Heating Operation.* Adjust the controls to lock-out the heating during the summer months and shoulder seasons. Fewer operating hours will reduce fuel use and emissions.

23. *Calibrate Controls.* Check and calibrate corridor ventilation unit controls. Adjust or replace temperature control if it is out by more than 0.5 °C. Adjust all set points to meet the minimum requirements of the corridors without compromising comfort conditions.

Cautions

- Maintenance personnel must have appropriate training and experience before attempting to service, repair and troubleshoot the HVAC systems.
- Procedures that are beyond the capabilities of the maintenance personnel should be carried out by qualified contractors.
- Always disconnect the power before servicing. For maximum safety, disconnect the power supply at the electrical panel.
- Regular visual inspections should be conducted to check the conditions for efficient system operation.

Where to Turn

For basic measures, use in-house staff or incorporate in maintenance service contract.

Measures directed at gas-fired equipment should be performed by a qualified contractor.

Procedure V-2: Tuning up a Central Heat Recovery System

What is a Central Heat Recovery System?

A heat recovery system captures heat from warm air leaving the building through the central exhaust system and uses it to heat corridor ventilation air. In the summer, when the exhaust stream is cooler than the incoming air, the system pre-cools the incoming corridor air. Heat recovery systems are not considered practical in buildings without central exhaust.

The energy recovery system most commonly used in MURBs is the "run-around" system. Such a system will include a coil added to the corridor air system, a coil in the exhaust stream, and a pump and piping to move a glycol mixture from one to the other. Two other energy recovery systems used in MURBs are rotary wheels and heat pipes. If the corridor ventilation air stream and the exhaust stream pass next to each other through opposite sides of an enclosure, the enclosure likely contains either a wheel or a heat pipe system.

Description of Tune-up

Performing routine maintenance procedures on heat recovery systems can result in improved system performance, energy savings, and longer equipment life. Tune up a heat recovery system by cleaning the heat exchange surfaces twice a year and cleaning or replacing filters every two to three months. In the case of run-around systems, twice a year you should check that the pump is working, that the system has adequate glycol, and that the coils are clean.

Benefits

- Reduced fuel consumption, utility cost and greenhouse gas emissions
- Increased fan system capacity
- Longer service life for exhaust and make-up air fans and consequently deferred capital replacement cost
- Increased operating reliability and less long term maintenance costs
- Improved space comfort and indoor air quality conditions

Implementation

Run-Around Heat Recovery Systems

1. Turn off the corridor ventilation system and the central exhaust system.
2. Locate the coil in the exhaust stream. Remove the filter from the duct. In some cases, filters are washable. If the filter in your system is washable, vacuum it first and then wash it in soapy water. If it is disposable, replace it. Dirty air filters result in a restriction of airflow, and consequently, reduced capacity and performance, and an increase in fan energy consumption. Be sure to use the filter recommended by the manufacturer.
3. Vacuum or brush any accessible surfaces around the filter.
4. Clean the coil twice a year. Vacuum the coil with the dusting or extender attachments of the vacuum. Use a coil brush to loosen dust from the coil before vacuuming. Use a fin comb to clean between the fins and straighten bent fins to normal position. Be cautious about straightening fins, as they can be fragile. Before replacing the enclosure, visually inspect the coil. If it is damaged, have it repaired or replaced.

5. If there is a condensate (drip) pan under the coil, clean it as well and pour a litre of water into the drain to check that it is free-running.
6. Look down the duct as far as you can with a flashlight, to visually inspect it for dust, dirt, grease, or moisture. If exhaust ducts are dirty, have them professionally cleaned.
7. Locate the heat exchanger coil in the corridor ventilation system unit. There may be an additional filter before the heat exchanger coil. If not, follow the instructions in Procedure V-1 for cleaning the filters in the corridor ventilation system unit. If the heat exchange coil has its own filter, remove it and clean or replace it if necessary. Refer to step 10 above for further information.
8. Vacuum or brush any accessible surfaces around the filter.
9. Clean the coil twice a year. Refer to step 4 above for further information.
10. If there is a condensate (drip) pan under the coil, clean it as well and pour a litre of water into the drain to check that it is free-running.
11. A run-around heat recovery system uses a pump to circulate fluid between the two coils. The pump will be small and will typically be permanently lubricated. It should run whenever the corridor ventilation system and exhaust fans are operating. If it stops working, have it serviced.
12. The run-around system must have an adequate supply of glycol to function. Your system should have a sight glass for checking the glycol. If the level appears to be low, glycol should be added. If you see bubbles, air needs to be bled out of the system. If the glycol has changed colour or appears dirty, it needs to be changed. A qualified service technician can perform this work.
13. Your system may have an automatic defrost, to ensure that frost does not build up on the coil in the exhaust stream. If the airflow through the recovery system becomes restricted, but the filters are clean and nothing else is blocking ducts, the heat exchange core may be frozen. Have a qualified contractor check the automatic defrost system and adjust it if necessary. If there is no defrost, you may need to have one installed.
14. Turn the exhaust and corridor ventilation system fans back on when finished servicing the heat recovery system.
15. The glycol pump should run whenever the fans are operating. Check to ensure this is the case.

Rotary Wheel Heat Recovery Systems

16. Turn off the corridor ventilation system and the central exhaust system.
17. Locate the wheel where the supply and exhaust ducts pass next to each other. Remove the filters from the ducts. In some cases, filters are washable. If the filters in your system are washable, vacuum them first and then wash them in soapy water. If they are disposable, replace them if necessary. Loaded air filters result in a restriction of airflow, and consequently, reduced capacity and performance, and an increase in fan energy consumption. Be sure to use the filters recommended by the manufacturer.
18. Vacuum or brush any accessible surfaces around the filters.

19. Clean the wheel twice a year. Follow the manufacturer's instructions on cleaning procedures. Some wheels are treated with a dessicant material and must not be wetted. Before replacing the enclosure, visually inspect the wheel. If it is damaged, have it repaired or replaced.
20. Rotary wheels are turned by electric motors connected to the wheel with a belt or chain. Often the motors are variable speed units that may require more frequent inspection and maintenance than induction motors. Follow the manufacturer's instructions for motor maintenance. Inspect the connecting belt or chain for wear and proper tension.
21. If there is a condensate (drip) pan under the wheel, clean it and pour a litre of water into the drain to check that it is free-running.
22. Look down the ducts as far as you can with a flashlight, to visually inspect them for dust, dirt, grease, or moisture. If ducts are dirty, have them professionally cleaned.
23. Your system may have an automatic defrost, to ensure frost does not build up on the wheel during the winter months. If the airflow through the recovery system becomes restricted, but the filters are clean and nothing else is blocking ducts, your wheel may be frozen. Have a qualified contractor check the automatic defrost system and adjust it if necessary. If there is no defrost, you may need to have one installed.
24. Rotary wheel systems usually have a speed control that varies the rotation speed to modulate the amount of heat transferred. Have a qualified contractor ensure that this system is working properly.
25. Turn the exhaust and corridor ventilation fans back on when finished servicing the heat recovery system.

Heat Pipe Systems

26. Turn off the corridor ventilation system and the central exhaust system.
27. Locate the heat pipe exchanger where the supply and exhaust ducts pass next to each other. Remove the filters from the supply and exhaust duct. In some cases, filters are washable. If the filters in your system are washable, vacuum them first and then wash them in soapy water. If they are disposable, replace them. Loaded air filters result in a restriction of airflow, and consequently, reduced capacity and performance, and an increase in fan energy consumption. Be sure to use the filters recommended by the manufacturer.
28. Vacuum or brush any accessible surfaces around the filters.
29. Clean the heat pipes and fins twice a year. Vacuum them with the dusting or extender attachments of the vacuum. Use a coil brush to loosen dust from the heat pipes before vacuuming. Use a fin comb to clean between the fins and straighten bent fins to normal position. Be cautious about straightening fins, as they can be fragile. Before replacing the enclosure, visually inspect the exchanger. If it is damaged or leaking, have it repaired or replaced.
30. If there is a condensate (drip) pan under the exchanger, clean it as well and pour a litre of water into the drain to check that it is free-running.
31. Look down the ducts as far as you can with a flashlight, to visually inspect them for dust, dirt, grease, or moisture. If ducts are dirty, have them professionally cleaned.

32. Your system may have an automatic defrost, to ensure that frost does not form on the heat pipes and fins. If the airflow through the recovery system becomes restricted, but the filters are clean and nothing else is blocking ducts, your heat exchanger may be frozen. Have a qualified contractor check the automatic defrost system and adjust it if necessary. If there is no defrost, you may need to have one installed.
33. Heat pipe systems usually have a tilt control that pivots the heat exchanger (up to 6°) to modulate the amount of heat transferred. Have a qualified contractor ensure that this system is working properly. Inspect the pleated, flexible connections to the duct system to ensure they are not leaking.
34. Turn the exhaust and corridor ventilation system fans back on when finished servicing the heat recovery system.

Note: Some apartments may be equipped with small residential heat recovery ventilators to supply outdoor air to the apartment and to exhaust kitchen and bathroom areas. Tune-ups for in-suite HRVs include:

1. Confirm the presence of airflow at outdoor hoods and interior supply air grilles and exhaust air louvers. If the flow at any of the diffusers or louvers seems low, a ventilation contractor may be required to balance the system.
2. Adjust speed control (either on the HRV itself or on a centrally located panel) to ensure appropriate changes in airflow. If HRV is equipped with a humidity controller, adjust the controller to ensure it activates higher flow operation. Note any problems for later action.
3. Check ducts leading to, and from the HRV. The duct connections should be tight. The ducts should be properly supported with no visible sags between supports. The polyethylene wrap on some of the ducts must be free of tears and holes and must be tightly sealed to the duct where it is attached to the HRV and where the duct terminates at the outside wall (may not be visible).
4. Deactivate the HRV by disconnecting the electricity. Open access panel and inspect/clean filters. Remove heat recovery core and inspect with a trouble light to ensure passages are clear and clean. Otherwise follow manufacturer's instructions for cleaning the core(s). Vacuum out the interior of the HRV cabinet. Ensure motor-fan sets can move freely and are properly mounted. Replace filters and core (ensure positioning of core is correct before replacing). Check and clean condensate pan under HRV core. Pour 1 litre of water into the pan to ensure it drains properly. Check drain and connection under the HRV—ensure drain is properly terminated in a trapped plumbing connection, floor drain or service sink. Close access panel and reconnect power.
5. Clean outdoor hoods and screens.

Cautions

- Maintenance personnel must have the capability and experience to service, repair and troubleshoot heat exchange systems.
- Regular visual inspections should be conducted to check the conditions for efficient system operation.

Where to Turn

Use in-house staff or incorporate in maintenance service contract.

Procedure V-3: Tuning up Exhaust Systems

What is a Central Exhaust Fan?

A central exhaust system draws air from the kitchen and bathroom exhaust grilles in the suites and expels it through a single outlet, usually on the roof. Sometimes, there is more than one central exhaust system serving the building. The fan moving the air is located near the outlet, and is typically a centrifugal fan. A centrifugal fan characteristically has a scroll-shaped housing, with an impeller that resembles a waterwheel. Less commonly, the fan may be the axial type. An axial fan has a more circular housing, with an impeller that resembles an airplane propeller.

What are In-suite Exhaust Fans?

In-suite exhaust fans can be found in the bathroom and kitchen areas. Bathroom fans are typically ceiling mounted paddle wheel devices characterized as being noisy and relatively ineffective. Kitchen exhaust fans are typically residential range hoods installed over the stove. The fans are ducted laterally out through the exterior walls of the suite.

Description of Tune-up

Performing routine maintenance procedures on exhaust fan systems can result in improved indoor air quality, energy savings, and longer equipment life. For large fans (over 7.5 kW or 10 hp.), a qualified technician can test the performance by measuring airflow rate and power consumption. The fans found in MURBs typically do not exceed 1.5 kW (2 hp.), so much simpler operational tests are appropriate. Tune up the fan by cleaning the wheel and housing, making sure the inlet duct and fan discharge are clear of debris, and lubricating according to the manufacturer's instructions. If the fan is 1.5 kW (2 hp.) or larger, an annual service is likely adequate. For smaller fans, intervals of two years or longer would be more appropriate.

This procedure is applicable to fans that provide laundry exhaust or ventilate parking garages in MURBs.

Many MURBs use in-suite fan systems that directly exhaust kitchen and bathroom areas to the outside. The fans in these systems are small—the tune-up should consist primarily of checking airflow, cleaning the fan, ensuring that the exhaust duct is unobstructed and the outdoor vent damper opens and closes properly.

Refer to Section 2 for opportunities to reduce building air leakage and control air movement in the building when tuning up building exhaust systems.

Benefits

- Reduced fuel consumption, utility cost and greenhouse gas emissions
- Increased exhaust air flow performance
- Longer equipment service life and consequently deferred capital replacement cost
- Increased operating reliability and less long term maintenance costs
- Improved ventilation performance in bath and kitchen areas

Implementation

Central Exhaust Fan Checks and Tune-ups

1. *Check Fan Performance.* Using a handheld smoke generator, check that air is flowing into the kitchen and bathroom exhausts in the suites when the exhaust system is operating. A piece of tissue paper should be held tightly against the exhaust grille. At the central fan, check that air is flowing smoothly from the discharge.
2. *Check and Adjust Motor Drive.* Check to ensure that the motor and fan are properly aligned and adjusted. Excessive vibration is often the best indication of motor/fan misalignment. Improper alignment can cause an increase in motor energy consumption and cause damage to the drive. Ensure drive belts are tight and not worn.
3. *Lubrication.* Lubricate the components, such as couplings, shaft bearings, and supports with proper lubricants and at intervals recommended by the manufacturer. Following this procedure will ensure maximum efficiency of operation.
4. *Motor Lubrication.* Motors in these units may be permanently lubricated, depending on age. If the motor in your unit requires lubrication, it will be at much longer intervals than the fan itself—not more than every fifth fan servicing. These motors will generally be oil-lubricated. Follow the manufacturer's instructions to keep the oil reservoir filled with the right grade and type of oil. Do not mix different kinds of oils.
5. *Fan Cleaning.* Fans should be cleaned periodically to maintain their efficiency. Dust build-up on blades and housing interior reduces airflow.
6. *Check for Fan Noise and Vibration.* Fan noise and vibration can be caused by one or more factors:
   - fan wheel out of balance;
   - worn or damaged bearings;
   - insufficient isolation;
   - poor alignment;
   - corrosion.

   Corrective repairs and adjustments will improve fan efficiency.

Exhaust System Checks

7. *Check Ducts for Dust Build-up.* Where accessible, inspect the inside of the exhaust ducts for cleanliness. If access panels are small, use a flashlight and mirror to visually inspect for dust, dirt, grease, or moisture. If ducts are dirty, have them professionally cleaned.
8. *Where Applicable, Check the Heat Recovery System.* If your building has a heat recovery system (described in the side-bar) you should check to ensure it is working well. Refer to Procedure V-2 for further details.
9. *Vacuum Grilles and Inside Ducts.* Remove exhaust grilles and vacuum them. Vacuum inside the ducts as far as possible. If dust build-up is excessive, have the ducts professionally cleaned.

Control System Optimization

10. *Check the fan controls to optimize system operation.* Typically exhaust fans in MURBs do not have speed controls. In many cases they run continuously, but in others there is a time clock for scheduling fan operation. In general the scheduled shutdown time for the exhaust system should be similar to the schedule for the corridor ventilation system.

In-suite Exhaust Fans

11. *Check bathroom and kitchen exhaust fans.* Typically exhaust fans in bathrooms are ceiling mount paddle wheel type. Newer buildings may have centrifugal fans. Strong airflow should be detectable at the intake grille. Tune-up procedures include:

    - Remove the lower panel of the exhaust fan and vacuum interior of housing and fan blades.
    - Check to see if the fan turns freely. Noise or grinding may indicate bearing failure—the exhaust fan may have to be replaced unless a new fan-motor assembly can be found.
    - Seal any holes or joints in the housing with aluminum foil type tape. Seal the fan housing to the drywall ceiling with foil tape as well.
    - Ensure any damper mounted in the fan-motor housing operates freely.
    - Check any exposed ductwork for leaks. If possible, ensure last two meters of the exhaust duct is insulated and has a plastic vapour barrier wrap that is sealed to the duct.
    - If possible, check to see that the outside exhaust hood is clear and the backdraft damper operates freely and closes when the exhaust fan is shut off. New gaskets may be required to ensure a good air seal.
    - If inadequate flow is detected at the exhaust fan or at the outdoor exhaust hood, a new exhaust fan may be necessary. Remove exhaust fan and check exhaust duct for obstructions. If the duct is clear, replace the exhaust fan. Bathroom exhaust fans should be rated to operate continuous and should have a sound rating of less than 1 sone; 25 L/s – 50 L/s is usually adequate but the available duct size may determine maximum airflow. For example, a 3-inch (75 mm) duct may handle up to 25 L/s but not 50 L/s.
    - If replacing a bathroom fan, consider installing a manual timer to control operation or an automatic control that operates the fan when humidity in the bathroom rises above a preset limit.

Cautions

- Maintenance personnel must have the capability and experience to service, repair and troubleshoot fan systems.
- Disconnect power before servicing fans. For maximum safety, disconnect the power supply at the electrical panel.
- Regular visual inspections should be conducted to check the conditions for efficient system operation.

Where to Turn

Use in-house staff or incorporate in maintenance service contract.

5. Domestic Hot Water Systems

This section explains how to tune up the domestic hot water system in your building.

Most MURBs in Canada have central systems for supplying domestic hot water (DHW). Gas-fired and electric systems make up the majority of these central systems (**DHW Type A**). In-suite electric water heaters are another type of DHW system found in Canadian MURBs (**DHW Type B**). Central hot water systems with electric heat are common in some regions (**DHW Type C**) and oil-fired systems are also found in Atlantic Canada (**DHW Type D**).

Once you have determined which type of hot water system your building has, the following table will help you choose the procedures to help make your operation more efficient:

Procedure		System Types
DHW-1	Tuning up a Gas-fired DHW Tank	DHW Type A
DHW-2	Tuning up an Electric DHW Tank	DHW Types B and C
DHW-3	Tuning up an Oil-fired DHW Tank	DHW Type D
DHW-4	Tuning up a DHW Circulation Pump and Motor	DHW Types A, C, and D
DHW-5	Recirculation Pump Shutdown	DHW Types A, C, and D
DHW-6	Adjusting the Temperature in a DHW System	DHW Types A, C, and D
DHW-7	Adjust DHW Pressure	All types

5.1 Why Tune Up the DHW System?

DHW uses more energy in a MURB than it does in a typical commercial building. It typically represents the second largest energy consumption in MURBs. Furthermore, many of the procedures for tuning up DHW will save water as well as energy, further reducing your operating costs.

Procedure DHW-1: Tuning up a Gas-fired DHW Tank

Description

Tune up a gas-fired tank water heater by testing and improving combustion efficiency and by adding insulation to the tank and distribution piping.

Most of the following tune-ups that involve burners, controls, heat exchangers and venting systems should be done by a qualified contractor. Such tune-ups are described to familiarize property owners, manager and custodial staff with the opportunities to improve water heating system performance.

Benefits

Benefits of boiler testing include:

- reduced fuel consumption and lower energy costs;
- increased DHW capacity;
- extended life for boilers and heaters;
- reduced time to heat water;
- cleaner boiler operation for increased reliability.

Benefits of insulation include:

- lower heat loss from DHW pipes and tanks, and therefore lower energy costs;
- reduced water costs, due to less need to run water until pipes warm up;
- improved hot water distribution;
- increased occupant satisfaction;
- cooler temperatures in boiler rooms.

Implementation

Buildings with centralized domestic hot water systems will have one or more tank type water heaters. Typically, large buildings will install a number of water heaters rather than a single large one. If they are gas-fired, you can save energy by testing their combustion efficiency and making adjustments to improve it.

Combustion efficiency testing for the water heaters typically found in MURBs is needed to ensure proper operation.

You can also install extra insulation around the tank and distribution piping in many cases. The insulation should last for the life of the system. Replace it if it gets wet or becomes worn.

Boiler service should be undertaken by a qualified tradesperson. Tank insulation should be installed by a professional insulation contractor. Consult the "Where to Turn" section of this procedure.

Tuning up a gas-fired water heater will involve the following steps:

Boiler Efficiency Checks

Most of these checks require the expertise of a qualified contractor but on-site staff can use this listing to be familiar with the type of service done:

1. *Check Fresh Air Supply.* Air openings to the boiler room from outside must be kept wide open and free of restrictions to flow. Sufficient fresh air supply is necessary to ensure optimum combustion and efficiency.
2. *Check Flue Gas Venting.* Check that the vent has no obstructions and is in good condition. Proper venting is essential to ensure efficient combustion. Insufficient draft or overdraft promotes hazards and inefficient burning.
3. *Check Burner Condition.* Dirty burners or burner orifices will cause the boiler output rate and thermal efficiency to decrease.
4. *Check Heat Transfer Surfaces.* Internal and external build-up of soot and scale on the heating surfaces reduces heat transfer efficiency.
5. *Combustion Analysis.* Perform a flue gas analysis. (Note: for atmospheric—natural draft—boilers, the gases must be sampled before the draft hood). The following information is typically obtained and recorded in order to determine boiler combustion efficiency: flue gas temperature and concentrations of O_2, CO, CO_2; inlet fuel pressure; draft pressure; and water temperatures entering and leaving the boiler.

Boiler Efficiency Tune-ups

Task 6 should be undertaken by a qualified contractor. The information is provided to assist building staff in supervising the project.

6. *Tune-ups:* As part of routine maintenance, or if the combustion efficiency determined by the flue gas analysis is less than the boiler manufacturer's recommendation, then have one or more of the following corrective actions taken to improve combustion and heat transfer efficiency:
   i. Clean the burners.
   ii. Clean the fire-side of the heat exchanger.
   iii. De-scale the water-side of the heat exchanger.
   iv. For atmospheric (natural draft) boilers, adjust the draft and/or fuel pressure in the manifold.
   v. For forced draft boilers, check and adjust the air and gas flow rates.
   vi. Ensure the combustion air grille is clean and that dampers (if installed) are operational and have gaskets in good condition. Clean and lubricate the damper actuator (if installed).

Insulating the Tank

7. DHW tanks should be insulated.
8. All insulation should be applied according to manufacturer's specifications and in compliance with applicable codes and standards.

Insulating Distribution Piping

9. Distribution piping should be insulated.
10. Give priority to uninsulated piping located in unheated areas such as basements, attics, and parking garages. Also give priority to larger pipes.
11. All insulation should be applied according to manufacturer's specifications and in compliance with applicable codes and regulations.

Short Cycling Water Heaters

You may find that your water heaters fire repeatedly for very short periods. This is called short cycling. This not only uses more energy, but also wears the equipment out faster. Boiler controls always have a differential between the temperature at which the boiler turns on and the temperature at which it turns off. If this is adjustable, it should be set to at least 3°C (5°F) and preferably 6°C (10°F).

If you have multiple water heaters, they should not all have the same firing set-points. The temperature set-points should be at least 3°C (5°F) and preferably 6°C (10°F) apart.

If in doubt about how to undertake this procedure, consult your boiler service company or a controls contractor.

Cautions

- Water heating boiler service must be done by a qualified contractor.
- Combustion air must be provided as specified in the installation code.
- Air shortage problems occur mostly with natural draft boilers.
- Visual inspections should be performed every few months to check for the following undesirable conditions:
  - a soft, lazy yellow flame instead of the normal hard, blue flame;
  - dirty or sooty heat exchanger surfaces;
  - damaged combustion chamber walls;
  - back drafting;
  - flame roll out;
  - condensation in boiler vent.
- Tank insulation and extensive pipe insulation jobs should be done by a professional insulation contractor. Tank and pipe insulation must meet smoke generation and flame spread requirements. Consult with a qualified contractor or local building code authorities.
- Always review provincial building regulations regarding fire safety requirements before applying insulation materials.
- For work conducted in the top floor ceiling, tops of pipe riser shafts should also be plugged and sealed to prevent air movement up the shafts (see Section 2 for further information).

Where to Turn

Boilers should be serviced by a qualified contractor. Look under Boiler Service in the phone book.

Building maintenance staff can undertake small pipe insulation jobs themselves, with materials purchased at a building supply store. However, only insulation products meeting flame spread and smoke generation requirements can be used. Consult local building and fire code authorities.

Larger insulation jobs, particularly insulation of the tank itself, should be done by a professional insulation contractor. Look under Insulation Contractors in the phone book.

Procedure DHW-2: Tuning up an Electric DHW Tank Heater

Description

Tune up an electric tank water heater by adding insulation to the tank and distribution piping. Individual electric tank water heaters in the suites can also be insulated, sediment drained, temperature setting checked, and heat traps installed.

Benefits

Benefits of insulation include:

- lower heat loss from DHW pipes and tanks, and therefore lower energy costs;
- reduced water costs, due to less need to run water until pipes warm up;
- improved hot water distribution;
- increased occupant satisfaction;
- cooler temperatures in boiler rooms.

Implementation

Buildings with centralized domestic hot water systems will typically have one or more tank type water heaters. To reduce losses, you can install extra insulation around the tank and distribution piping in many cases. The insulation should last for the life of the system. Replace it if it gets wet or becomes worn. **Tank insulation should be installed by a professional insulation contractor.** Consult the "Where to Turn" section of this procedure.

Tuning up an electric water heater will involve the following steps:

Draining the Tank to Remove Sediment

1. With in-suite tanks, sediment can build up in the tank, reducing tank efficiency. Drain the tank completely periodically to reduce sediment build up. Annual draining is often recommended, but this can be adjusted depending on the amount of sediment that accumulates in the tank. Installing good quality ball valves and removable connectors on the water supply to the tank and the hot water pipe from the tank, can make this task much easier. A good quality ball valve on the drain itself is also very helpful as the plastic valves provided with the tank often leak after being opened and closed.

Insulating the Tank

2. DHW tanks should be insulated.
3. For uninsulated or partially insulated central hot water tanks, consult a qualified contractor.
4. All insulation should be applied according to manufacturer's specifications and in compliance with applicable codes and standards.
5. In-suite electric tanks can be retrofitted with additional insulation "blankets" made for such applications.

Insulating Distribution Piping

6. Distribution piping should be insulated.
7. Give priority to uninsulated piping located in unheated areas such as basements, attics, and parking garages. Also give priority to larger pipes.
8. All insulation should be applied according to manufacturer's specifications and in compliance with applicable codes and regulations.

Heat Traps

For in-suite tanks, add heat traps to the hot and cold water service pipes when you replacing or servicing a tank. A heat trap is a rearrangement of the plumbing to add two U-bends to each of the two pipes running into the top of the tank. These U-bends, resembling the drain traps found under sinks, prevent the siphoning of hot water out of the tank when it is not in use. This work must be done by a plumber.

Cautions

- Tank insulation and extensive pipe insulation jobs should be done by a professional insulation contractor.
- Always review provincial building regulations regarding fire safety requirements before applying insulation materials. Tank and pipe insulation must meet smoke generation and flame spread requirements. Consult with a qualified contractor or local building code authorities.
- For work conducted in the top floor ceiling, tops of pipe riser shafts should also be sealed to prevent air movement up the shafts (see section 2 for further information).
- Before undertaking any work on an electric water heater, ensure that power is disconnected at the electrical panel. Disconnecting the power before draining is particularly important—the heating elements are likely to burn out if are allowed to operate without water around them.
- If the existing tank is old and the drain valve has not been opened in several years, it is best not to attempt to drain the tank until it is due for replacement, as corrosion may prevent re-closing the valve. Otherwise, plan to replace the valve as a part of the tune-up.

Where to Turn

Building maintenance staff can undertake modest pipe insulation jobs themselves, with materials purchased at a building supply store. Building maintenance staff can also insulate individual tank water heaters in the suites.

Larger insulation jobs, particularly insulation of the tank itself, should be done by a professional insulation contractor. Look under Insulation Contractors in the phone book.

Procedure DHW-3: Tuning up an Oil-fired DHW Tank Heater

Description

Tune up an oil-fired tank water heater by testing and improving combustion efficiency and by adding insulation to the tank and distribution piping.

Most of the following tune-ups that involve burners, controls, heat exchangers and venting systems should be done by a qualified contractor. Such tune-ups are described to familiarize property owners, manager and custodial staff with the opportunities to improve water heating system performance.

Benefits

Benefits of boiler testing include:

- reduced fuel consumption and lower energy costs. Oil is a dirtier fuel than natural gas, and tends to clog burners and coat heat exchangers with soot. Efficiency can drop by as much as 15% in one year;
- increased DHW capacity;
- extended life for boilers and heaters;
- reduced time to heat water;
- cleaner boiler operation for increased reliability;

Benefits of insulation include:

- lower heat loss from DHW pipes and tanks, and therefore lower energy costs;
- reduced water costs, due to less need to run water until pipes warm up;.
- improved hot water distribution;
- increased occupant satisfaction;
- cooler temperatures in boiler rooms.

Implementation

Buildings with centralized domestic hot water systems will typically have one or more tank type water heaters. If they are oil-fired, you can save energy by testing their combustion efficiency and making adjustments to improve it. Combustion efficiency testing for the water heaters typically found in MURBs should be done on an annual basis. In between, you should conduct visual checks to confirm that the combustion has not changed.

You can also install extra insulation around the tank and distribution piping in many cases. The insulation should last for the life of the system. Replace it if it gets wet or becomes worn.

Boiler service should be undertaken by a qualified tradesperson. Tank insulation should be installed by a professional insulation contractor. Consult the "Where to Turn" section of this procedure.

Tuning up an oil-fired water heater will involve the following steps:

Boiler Efficiency Checks

Most of these checks require the expertise of a qualified contractor.

1. *Check Fresh Air Supply.* Air openings to the boiler room from outside must be kept wide open and free of restrictions to flow. Sufficient fresh air supply is necessary to ensure optimum combustion and efficiency.
2. *Check Flue Gas Venting.* Check that the vent has no obstructions and is in good condition. Proper venting is essential to ensure efficient combustion. Insufficient draft or overdraft promotes hazards and inefficient burning.
3. *Check Burner Condition.* Dirty burners or burner orifices will cause the boiler output rate and thermal efficiency to decrease.

4. *Check Heat Transfer Surfaces.* Internal and external build-up of soot and scale on the heating surfaces creates an insulating effect that reduces heat transfer efficiency.

5. *Combustion Analysis.* Perform a flue gas analysis. (Note: for atmospheric—natural draft—boilers, the gases must be sampled before the draft hood). The following information is typically obtained and recorded in order to determine boiler combustion efficiency: flue gas temperature and concentrations of O_2, CO, CO_2); inlet fuel pressure; draft pressure; and water temperatures entering and leaving the boiler.

Boiler Efficiency Tune-ups

Task 6 should be undertaken by a qualified contractor. The information is provided to assist building staff in supervising the project.

6. *Tune-ups:* As part of routine maintenance, or if the combustion efficiency determined by the flue gas analysis is less than the boiler manufacturer's recommendation, then have one or more of the following corrective actions taken to improve combustion and heat transfer efficiency:

   i. Clean the burners. Inspect the burners for wear. Oil burners wear faster than gas burners and will occasionally need to be replaced.

   ii. Clean the fire-side of the heat exchanger.

   iii. De-scale the water-side of the heat exchanger.

   iv. Oil pressure is provided by a pump. Check the pump to ensure it is working well.

   v. For forced draft boilers, check and adjust the air and oil flow rates.

   vi. Ensure the combustion air grille is clean and that dampers (if installed) are operational and have gaskets in good condition. Clean and lubricate the damper actuator (if installed).

Insulating the Tank

7. DHW tanks should be insulated.

8. All insulation should be applied according to manufacturer's specifications and in compliance with applicable codes and standards.

Insulating Distribution Piping

9. Distribution piping should be insulated.

10. Give priority to uninsulated piping located in unheated areas such as basements, attics, and parking garages. Also give priority to larger pipes.

11. All insulation should be applied according to manufacturer's specifications and in compliance with applicable codes and regulations.

Short Cycling Water Heaters

You may find that your water heaters fire repeatedly for very short periods. This is called short cycling. This not only uses more energy, but also wears the equipment out faster. Boiler controls always have a differential between the temperature at which the boiler turns on and the temperature at which it turns off. If this is adjustable, it should be set to at least 3°C (5°F) and preferably 6°C (10°F).

If you have multiple water heaters, they should not all have the same firing set-points. The temperature set-points should be at least 3°C (5°F) and preferably 6°C (10°F) apart.

If in doubt about how to undertake this procedure, consult your boiler service company or a controls contractor.

Cautions

- Boiler service must be done by a qualified contractor.
- Combustion air must be provided as specified in the installation code.
- Air shortage problems occur mostly with natural draft boilers.
- Regular visual inspections should be performed to check for the following undesirable conditions:
  - a dirty, unstable flame, instead of the normal clear yellow or orange flame;
  - dirty or sooty heat exchanger surfaces;
  - damaged combustion chamber walls;
  - back drafting;
  - flame roll out;
  - condensation in boiler vent.
- Tank insulation and extensive pipe insulation jobs should be done by a professional insulation contractor.
- Always review provincial building regulations regarding fire safety requirements before applying insulation materials. Tank and pipe insulation must meet smoke generation and flame spread requirements. Consult with a qualified contractor or local building code authorities.
- For work conducted in the top floor ceiling, tops of pipe riser shafts should also be plugged and sealed to prevent air movement up the shafts (see section 2 for further information).

Where to Turn

Boilers should be serviced by a qualified tradesperson. Look under Boiler Service in the phone book.

Building maintenance staff can undertake modest pipe insulation jobs themselves, with materials purchased at a building supply store. Insulation flame spread and smoke generation characteristics must be suitable for the application. Consult with local building authorities if unsure.

Larger insulation jobs, particularly insulation of the tank itself, should be done by a professional insulation contractor. Look under Insulation Contractors in the phone book.

Procedure DHW-4: Tuning up a DHW Circulation Pump and Motor

Description

Tune up the circulator pump and motor for the centralized domestic hot water system in your building, by lubricating and cleaning it, replacing seals and other parts as needed, and tuning up the motor when needed. Annual pump servicing should be sufficient for larger pumps. For pumps below 2 hp., intervals of two years or longer will be more appropriate. The motor should be serviced every fifth time the pump is serviced.

The most simple tune-up involves a "touch-and-listen" test to determine if the motor is running hot or if there is excessive vibration and noise coming from the motor, drive assembly or pump. If so, a call to a qualified service contractor will be in order.

The following tune-ups can be relatively complex, time consuming and must be done quickly to limit the amount of time the hot water system is out of service. It is recommended that the following tune-ups be performed by a qualified contractor. The tune-ups are described to inform building staff of the opportunities and to enable them to specify and supervise the work.

Benefits

- The primary benefit of regular pump tune-ups is longer equipment life. A well-maintained pump and motor will likely last 20 years. Poor maintenance could easily cut this time in half.
- Poor maintenance will cause increased electricity use due to higher friction losses.
- Poor maintenance may also result in increased leaks.
- Poor maintenance may also result in unexpected breakdowns, causing loss of hot water to the occupants.

Implementation

Buildings with centralized domestic hot water systems may have one or more circulator pumps to provide the hot water to the suites. The pumps in use in your building may be of various brands and types. Locate and have the motor's manual on hand for the servicing contractor.

Tuning up a typical centrifugal pump will involve the following steps:

Preparation

1. Consult the pump service manual to determine what tools are needed. Obtain a seal replacement kit for the pump.
2. Notify the users of the system involved that there will be an interruption of service.
3. Stop the pump and disconnect the power supply to the motor.
4. Close valves in the suction and discharge pipes.
5. Release the pressure from the pump and its surrounding piping system.
6. Following the service manual the pump will be disassembled to gain access to the seals. Many modern pumps have a rear pull-out design that makes this easier.

Maintaining the Pump Seals and Bearings

7. Pumps may have either packing gland seals or mechanical seals. Packing glands are multiple rings of flexible, low-friction packing material compressed against the shaft and pump casing. Forced lubrication is usually provided between the shaft and the rings. Mechanical seals consist of spring loaded rings of a rigid, low-friction material sliding against finely finished mating surfaces.

8. If the pump has packing gland seals, have the stuffing box glands checked for free movement and the packing inspected. Drain and refill oil lubricated bearings and check oil wicks—if the wicks are scored, burnt, or waxy, replace them. Check the quantity and consistency of grease in grease lubricated bearings. Lubricate packing gland bolts.
9. If the pump has mechanical seals, clean, inspect, and lubricate the bearings and their seals. Some modern pumps feature slip-on shaft sleeves to make seal maintenance easier. Examine the clearances and surfaces to ensure that the seals are still maintaining the critical tolerances that stop leakage and prevent air from being drawn into the system. Check shaft movement.
10. Consider replacing the seals while you have the pump disassembled. They may not need replacement quite yet, but it's much easier to do when the pump is already apart.
11. Be very careful when installing seals. Don't touch the surfaces with dirty hands. Use soapy water to slide the seals onto the shaft, not a petroleum lubricant. Don't run the pump while the seal is dry.

Maintaining Other Parts of the Pump

12. Clean the impeller.
13. Check and clean seal liquid lines.
14. Check and clean any associated strainers and coolers. If strainers are severely clogged with debris, consider having the system flushed. This can be a problem particularly with new systems, if the installers neglected to flush out construction debris before start-up.
15. Reassemble the pump.

Maintaining the Pump Motor

16. The motor that drives the pump will require less frequent lubrication than the pump itself—again, consult the service manual. In most cases, the motor should not require lubrication more than once every five years.
17. Most motors in this application will have roller or ball bearings. Generally they use grease as a lubricant. Some are sealed and need no maintenance, but others must be repacked with grease.
18. Follow the manufacturer's recommendations on the type of grease to use. Bearings should be about 1/3 full to avoid over-greasing. To ensure that the bearing is not over-greased, allow excess grease to run out of the drain plug for about 10 minutes after starting and before replacing the grease plug. Avoid mixing different types of grease, as some types are incompatible.
19. Some motors in this application may use plain bearings, made of a soft metal such as bronze. Oil is used to lubricate plain bearings. An oil ring is used to transport oil from the oil reservoir to the top of the shaft. If there is a sight plug in the top of the bearing, use it to confirm that the oil ring is working.
20. Keep the reservoir filled to the proper level with the grade and type of oil specified by the manufacturer. Do not mix different types of oil, as some are incompatible with others.
21. If the motor is of the open type, make sure the ventilation screens and shrouds are clean and unobstructed, that the motor is free of dirt and grease, and that the windings are free of dust, dirt, oil, grease, or moisture. If the environment is dirty or damp, and it is impossible to keep the motor clean, consider replacing it with a totally enclosed motor.

Completing the Job

22. Open the servicing valves to fill the pump with working fluid.
23. Reconnect the power.
24. Check pump and driver alignment. If the pump and motor are misaligned, correct the situation using shims under the motor.
25. Recalibrate all associated instrumentation.
26. Check pump performance against design ratings.
27. Replace worn out components and adjust impeller clearance if tests indicate the pump has lost performance.
28. Pump maintenance should occur either annually or semi-annually, depending on run hours, load, operating environment, and other factors. A good look at the pump parts during servicing should tell you if it needs more (or less) frequent servicing.

Cautions

- Notify the people affected before you turn a pump off for servicing. Occupants may have to make special arrangements if they will be without hot water.
- Working on a pump can be dangerous. There is a risk of electrical shock. Make sure the power is off—if the pump is connected to an emergency standby source of power, make sure that is off, too. If the power supply includes capacitors, do not touch the terminals.
- If you do not feel comfortable undertaking this procedure yourself, you can hire a contractor or you can seek training.

Where to Turn

To find a contractor to do pump maintenance, look under “Pumps—Repair and Installation” in your phone book. Building operations staff can obtain training on pump repair. There are training institutes and courses available on the internet. You may also want to approach your pump dealer for suggestions.

Upgrade Packing Glands

If your pump currently has packing gland seals, mechanical seals would reduce the friction losses by a factor of six. For most pumps, they are a cost-effective replacement. Furthermore, mechanical seals are available that are specially made to fit into pumps that were originally fitted with packing gland seals.

Pump Sizing

Many pumps are oversized for the application. Consider having an expert measure the load on your pump and determine whether a smaller pump and motor would do the job. Sometimes the re-sizing can be accomplished by trimming the impeller of the existing pump.

Energy Efficient Motors

Motors cost much more to run over their lifetime than they cost to buy. If the time has come to replace your pump motor, consider buying an energy efficient motor to replace it.

Procedure DHW-5: Adjusting the Temperature in a DHW System

Description

Tune-up the operation of a DHW system by adjusting DHW temperature.

Benefits

- Heat loss in the distribution piping system will be reduced, lowering energy costs.
- Savings from the change in normal supply temperature will be approximately 1 per cent for each degree reduction.
- Reduced water temperatures may help prevent the risk of scalding.

Implementation

In a building with centralized DHW systems, you should set the hot water supply temperature to the lowest safe level that will provide satisfactory supply of hot water to all occupants. In many buildings, domestic hot water temperature is set too high which increases energy consumption and costs and also poses a scalding risk.

Adjusting the supply temperature in your DHW system will involve the following steps:

Adjusting the Normal Supply Temperature

1. Temperature reductions should be limited to 2°C (4°F) increments at two-week increments until desired temperature is reached.
2. During the time of lowest demand (i.e., night time), turn on the furthest hot water tap and measure the water temperature using an accurate thermometer.
3. Readjust the DHW water temperature control set point until the water temperature from the same tap is at least 46°C (115°F).
4. Repeat during the time of maximum demand. If the thermometer reads lower than 46°C (115°F), raise the control set point until that temperature is reached.

Cautions

- *Legionella pneumonophilia*, the bacteria that cause Legionnaires disease, can colonize hot water systems maintained below 46°C (115°F). Service water heater temperatures of 60°C are recommended, however, only in conjunction with measures designed to ensure that water delivery temperature at each fixture is no more than 49°C. This can be accomplished by mixing service water heater water with return water to reduce the temperature of water delivered to the building.
- DHW supply temperatures that are too high pose a scalding risk. DHW supply temperatures above 49°C (120°F) will increase this risk.
- A lack of insulation on distribution piping may result in a large water temperature drop by the time it reaches taps furthest from the boiler. Complaints and significant water and energy waste may result.

Where to Turn

Building operations staff can do the reduction of normal DHW supply temperature.

Procedure DHW-6: Adjusting the DHW Pressure

Description

Adjust the water pressure at the top floor so that it will not fall below 170 kPa (25 psi) during times of maximum demand, and will not rise above 240 kPa (35 psi) during times of minimal demand.

Benefits

- High water pressure can increase hot and cold water use due to leakage of fixtures and pipe fittings under high pressure and due to excessive water forced through fixtures when they are operating.
- This procedure will reduce the energy consumption of booster pumps and DHW heaters.
- It will also reduce water consumption.
- High water pressure hazards and nuisance leaks will be reduced.

Implementation

In a building with domestic hot and cold water booster pumps, water pressure should be adjusted to minimize energy and water consumption.

A qualified service water contractor may be required to perform some of the following tasks.

1. Checking and adjusting water pressure requires the following instrumentation and controls:
   i. A pressure gauge on the hot and cold water lines at the top floor of each pressure zone, located as close as possible to the plumbing fixture farthest from each booster pump and/or the service water entrance.
   ii. A pressure gauge at the discharge of each booster pump, and at the service water entrance.
   iii. A pressure regulating valve at the service water entrance.
2. Pressure gauges should be calibrated by comparison with a gauge of known accuracy to ensure that they are working properly.
3. Adjust water pressure when water use is as low as possible, e.g., between 12:00 pm and 5:00 am.
4. Recheck water pressure during periods of hight water demand, e.g. between 7 and 8 a.m.
5. A satisfactory system would have a maximum flow pressure of no more than 275 kPa (40 psi) during low water use periods, and a flow pressure of at least 170 kPa (25 psi) during times of high water usage.
6. Larger differences in pressure may indicate undersized piping or piping restriction by lime.
7. Typical pressure regulating valves are adjusted manually with a handle (more expensive models may have a dial read-out showing the pressure setting). Adjust the valve at times of low use. Always begin by adjusting only a small amount and assessing the change.

Cautions

- Water pressure lower than 170 kPa could lead to occupant complaints.
- Water pressure lower than 170 kPa can result in unsatisfactory rinse cycles in washing machines, as well as longer filling times for sinks, bathtubs, and water closet flush tanks.
- Pressure above this level will cause excessive flow rates and waste of water in showers, toilets, rinse cycles of dishwashers and washing machines, and any operation where water flows freely to the drain.
- A qualified plumbing tradesperson is required for this procedure.

Where to Turn

This work should be done by a qualified plumbing tradesperson.

6. Electrical Systems

This section explains how to tune up the electrical systems in your building, focusing on lighting and appliances.

6.1 Lighting

If your building is like most, the lighting in the suites is primarily incandescent, with some fluorescent lighting. Corridor lighting in most buildings may be fluorescent or incandescent. If the lighting in the common areas of your building is primarily incandescent, a lighting retrofit would be an attractive thing to consider. There are also opportunities to retrofit older fluorescent fixtures with more efficient fixtures.

The following table will help you choose the lighting tune-up procedures that will help make your buildings' operation more efficient:

Procedure		System
El-1	Tuning up Suite Lighting	Suite Lighting
El-2	Tuning up Common Area Lighting	Corridors and Common Areas

6.2 Appliances

The appliances typically found in MURBs include refrigerators, ranges, freezers, washers, dryers, and dishwashers. Washers and dryers are sometimes in the suites and sometimes in common.

Appliance tune-ups will not typically have the rapid payback of some of the other measures in this manual. In fact, for refrigerators, ranges, and clothes washers, new models are significantly more efficient than old ones. Replacement may be a financially attractive option to consider.

If replacement is not contemplated in the near future and tune-up work is already taking place in the suites, there are some appliance tune-up measures that can easily be added to the work. The following table shows the appliance tune-up procedures you can do:

Procedure		System
El-3	Refrigerator Coil Cleaning	Refrigerators
El-4	Clothes Dryer Tune-up	Clothes Dryers

6.3 Why Tune Up Lighting and Appliances?

In the average MURB, about one quarter of the energy is used for electrical equipment, including lights, appliances, and elevators. The procedures in this section will not only make lighting and appliances use energy more efficiently, but will also help the systems provide a higher level of service and safety to the occupants.

Procedure EI-1: Tuning up Suite Lighting

Description

Clean fixtures and replace incandescent lamps with screw-in compact fluorescents wherever they will fit in permanent fixtures.

Benefits

- Regular cleaning of fixtures, lamps, and lenses, annual window cleaning, and regular cleaning or painting of surfaces will all help to get the most light from existing lighting.
- Replacing one 60-W incandescent lamp with a compact fluorescent lamp will save up to 45 kWh of electricity every year, if the fixture is used 1,000 hours per year.
- Compact fluorescent lamps typically last 10 times longer incandescent lamps, reducing maintenance and replacement cost.

Implementation

Most suite lighting in Canadian MURBs is incandescent. Replacement of incandescent fixtures with fluorescent fixtures is typically a cost-effective retrofit. If a retrofit is not contemplated in the near future, it is important to make the existing fixtures as efficient as possible. To do this, follow these steps:

1. Clean fixtures, lamps, and lenses by wiping off the dust. Turn off incandescent bulbs before cleaning them and allow them to cool; the cooling effect of water could shatter them.
2. Replace lenses if they have become yellow with age.
3. Advise occupants to clean the lamps and shades in their own floor and table lamps.
4. Many incandescent fixtures can accept screw-in compact fluorescent lamps as replacements for the incandescent lamps. A 15-W compact fluorescent will produce as much light as a 60-W incandescent.
5. Use lamps with “warm” or “natural” light colour. Ideally, the compact fluorescents should be used in the fixtures that are on for the longest periods of time. Consult with the occupants on where to install them.
6. Establish a regular pattern of cleaning fixtures, lamps and lenses every 6 to 24 months. Extremely dirty lighting systems can produce 40 per cent less light than clean ones. Fixture cleaning can be coordinated with a group re-lamping program (see box).
7. Clean windows annually. Clean windows let in more light and reduce the need for interior lighting.
8. Clean or repaint walls and ceilings every two to three years. Dirt on surfaces reduces the light they reflect.

Group Re-lamping

Consider a group re-lamping program. All types of lamps gradually decrease in light output as they approach the end of their life. Start a program to replace all lights at a scheduled time, based on their average lifetime. It can cost as little as one-tenth as much labour per lamp and also allows you to get bulk discounts on the lamps you buy. You'll get better lighting quality, because you'll avoid the low-output period at the end of the lamp's life.

Lighting Retrofits

If the suite lighting in your building is all incandescent, consider a lighting retrofit for high-use fixtures such as those in kitchens, hallways, and bathrooms. Paybacks on fluorescent systems can be quite attractive, especially with T8 systems. In addition to energy savings, you'll reduce maintenance costs. If your lighting levels are too low, you can bring them up to code and save energy at the same time. If dimmers or multi-level switches are not currently available in the suites, consider adding them so the occupants can reduce their own lighting levels as required.

Cautions

- Be cautious about reducing lighting levels in occupant space as the occupants will simply purchase additional lighting.
- Do not use regular screw-in compact fluorescent lamps in a fixture with a dimmer or multi-level switch. Specialized lamps are available for these applications.
- Test compact fluorescents to make sure they physically fit into the light fixtures, shades, and lenses before buying them in quantity.
- Test the quality of light and occupant satisfaction with the new lights before committing to an entire building retrofit.

Where to Turn

Building maintenance staff can undertake many parts of the suite lighting tune-up without outside assistance. Specifically, this could include fixture cleaning, replacement of lenses, window cleaning, and cleaning or painting of surfaces. Building staff can also undertake the replacement of incandescent bulbs with screw-in compact fluorescent lamps.

Many occupants can be enlisted to assist with maintenance of the lighting in their suites, once the benefits are explained to them. Their support will ensure that the savings persist with time, and may also reduce the labour cost to the building owner.

Procedure EI-2: Tuning up Common Area Lighting

Description

Reduce lighting levels in corridors, stairwells, lobbies, and other common areas, where appropriate. Clean fixtures and replace incandescent lamps with screw-in compact fluorescents wherever they will fit. LED and other low-energy options are available for "Exit" lights.

Benefits

- Regular cleaning of fixtures, lamps, and lenses, and regular cleaning or painting of surfaces will both help to get the most light from existing lighting systems.
- Reducing lighting levels in a corridor that is overlit by a factor of two, twenty-four hours per day, can save about 7 kWh of electricity every year for each square meter of floor area.
- Replacing incandescent lamps with compact fluorescent lamps can save an additional 5 kWh of electricity every year for each square meter of floor area.
- Compact fluorescent lamps typically last 10 times as long as incandescent lamps, reducing maintenance and replacement cost.

Implementation

Incandescent lighting is still commonplace in the corridors, stairwell and other common areas of older MURBs. Replacement of incandescent fixtures with fluorescent fixtures is typically a cost-effective retrofit. If a retrofit is not contemplated in the near future, it is important to make the existing fixtures as efficient as possible. To do this, follow these steps:

1. Clean fixtures, lamps, and lenses by wiping off the dust. Turn off incandescent bulbs and let them cool before cleaning them: the cooling effect of water could shatter them.
2. Replace lenses if they have become yellow with age.
3. Measure the lighting levels. Lighting levels in corridors should be at least 150 lux (15 foot-candles). If many residents are seniors or are visually impaired, 200 lux (20 foot-candles) may be more appropriate. The easiest way to measure lighting levels is with a light meter. These are expensive, but most energy auditors will have one.
4. If lighting is substantially brighter than the levels indicated above, choose a test area in the building and try removing lamps or using lower-wattage lamps until the level is appropriate.
5. Many incandescent fixtures can accept screw-in compact fluorescent lamps as replacements for the incandescent lamps.
6. Use lamps with "warm" or "natural" light colour in common areas. A 15-W compact fluorescent will produce as much light as a 60-W incandescent. Try replacing the incandescent lamps in the test area with compact fluorescents.
7. If the occupants accept the new lighting in the test area, implement the same pattern of lamp removal and replacement with compact fluorescents throughout the common areas.
8. Establish a regular pattern of cleaning fixtures, lamps and lenses every 6 to 24 months. Extremely dirty lighting systems can produce 40 per cent less light than clean ones. Fixture cleaning can be coordinated with a group re-lamping program (see box).

9. Clean or repaint walls and ceilings every two to three years in the common areas. Dirt on surfaces reduces the light they reflect.

Group Re-lamping

Consider a group re-lamping program. All types of lamps gradually decrease in light output as they approach the end of their life. Start a program to replace all lights at a scheduled time, based on their average lifetime. It can cost as little as one-tenth as much labour per lamp and also allows you to get bulk discounts on the lamps you buy. You'll get better lighting quality, because you'll avoid the low-output period at the end of the lamp's life.

Lighting Retrofits

If the corridor lighting in your building is still incandescent, consider a lighting retrofit. Paybacks on fluorescent systems can be quite attractive, especially with the new T8 systems. In addition to energy savings, you'll reduce maintenance costs. If your lighting levels are too low, you can bring them up to code and save energy at the same time.

Cautions

- Do not reduce lighting levels below 150 lux (15 foot-candles), or 200 lux (20 foot-candles) where the resident population includes many seniors or visually impaired people. Test any reductions in a small area of the building to assess resident reaction.
- Do not use regular screw-in compact fluorescent lamps in a fixture with a dimmer or multi-level switch. Specialized lamps are available for these applications.
- Test compact fluorescents to make sure they physically fit into the building's light fixtures, shades, and lenses before buying them in quantity.
- If you are concerned about the lighting levels or quality in the building's common areas, consult a lighting specialist to ensure light levels comply with local codes and standards.
- Do not use compact fluorescent lamps outside unless they are rated for outside use.

Where to Turn

Building maintenance staff can undertake many parts of the corridor lighting tune-up without outside assistance. Specifically, this could include fixture cleaning, replacement of lenses, and cleaning or painting of corridor surfaces. Building staff can also undertake the replacement of incandescent bulbs with screw-in compact fluorescent lamps.

Measurement of lighting levels requires a light meter—it is very difficult to do by counting fixtures, because light output per fixture is affected by so many factors. An energy auditor will typically have the tools to provide an estimate of lighting levels. Lighting contractors and engineers can also provide assistance. Qualifications to look for include membership in the Illuminating Engineering Society of North America (IESNA).

Procedure EI-3: Refrigerator Coil Cleaning

Description

Clean the condenser coils of the refrigerators in the suites.

Benefits

- Dirty coils increase compressor runtime. Clean coils will therefore reduce both energy use and wear and tear on the refrigerator.
- In the worst case, the refrigerator may not be able to maintain cooling with extremely dirty coils. Regular coil cleaning can therefore reduce appliance service calls.
- Reducing the dust under or behind the refrigerator and cleaning the pan eliminates a breeding area for molds and mildews. Keeping the area clean can therefore reduce allergy or asthma symptoms among the occupants.

Implementation

Refrigerators work by using an evaporating fluid to absorb heat into a set of coils inside the compartment. Then the fluid is moved into another set of coils either behind or underneath the refrigerator, where it condenses and rejects the heat to the room. If the exterior condenser coils get dirty, they are less efficient at transferring heat to the room. To clean them, follow these steps:

1. You will need a vacuum cleaner with dusting and extender attachments and a refrigerator coil cleaning brush (available at any hardware store).
2. Unplug the refrigerator before starting work.
3. Older refrigerators often have their coils on the back. Protect the floor and carefully slide the refrigerator out from the wall. The coils will look like thin tubes, possibly with fins attached like those in a car radiator.
4. Vacuum the coils carefully with the vacuum cleaners dusting attachment. Be careful—the coils are fragile!
5. Below the coils there is a pan to catch water that may overflow from the refrigerator during the defrost cycle. Remove this pan and clean it with an all-purpose surface cleaner. Put it back in place.
6. Slide the refrigerator back into place and plug it in.
7. Newer refrigerators usually have their coils behind a kick plate or grill underneath. Remove this kick plate by pulling on it firmly.
8. Use the brush to loosen the dirt on the coils. Use the vacuum extender attachment to vacuum up the loose dust. Again, be careful—the coils are fragile!
9. Below the coils there is a pan to catch water that may overflow from the refrigerator during the defrost cycle. Remove this pan and clean it with an all-purpose surface cleaner. Put it back in place.
10. Protect the floor and carefully slide the refrigerator out from the wall. With some refrigerators, there will be a second access plate at the back for cleaning the rear portion of the coils. If so, remove it and clean as in step 7.
11. Clean the dust out of the fan intake grill, on the rear of the refrigerator near the bottom.

12. Replace all access panels, slide the refrigerator back into place, and plug it in.
13. Establish a regular pattern of cleaning refrigerator coils every year.

Refrigerator Replacement

Refrigerator technology has advanced tremendously in the last 10 years or so. If the refrigerators in your building are over 10 years old, consider replacing them. New refrigerators use 30 per cent as much electricity as the old ones. The expected lifetime of a refrigerator is usually 15 to 20 years. If your occupants' refrigerators are approaching this age, you will be replacing them soon in any case. Consider replacing them early to save energy and avoid emergency service calls.

Cautions

- Be careful not to damage the coils while cleaning them.
- When sliding the refrigerator across the kitchen floor, it is best to protect the floor from damage. Appliance slides are available, but you can also use a scrap piece of vinyl flooring or a clean piece of plywood.

Where to Turn

Building maintenance staff can do refrigerator coil cleaning. Many occupants can be enlisted to assist with maintenance of the refrigerators in their suites, once the benefits are explained to them. Their support will ensure that the savings persist with time, and may also reduce the labour cost to the building owner.

Procedure EI-4: Clothes Dryer Tune-up

Description

Tune up dryers in suites or common areas by ensuring that they are properly vented. Check the lint trap and clean lint out of ducts, outdoor grilles and hoods, booster fans and the dryer cabinet. Ensure any booster fan is operating. If venting is clogged with lint, bent, compressed, or otherwise damaged, have it replaced.

Benefits

- The most significant benefit of this tune-up is safety. Many residential fires start in dryers, and lint build-up can be a significant culprit.
- Poor venting increases dryer runtime. A good, clean vent will reduce both energy use and wear and tear on the dryer.
- Energy savings up to 100 kWh per dryer per year can be expected.
- The dryer may not be able to dry the clothes with a vent that is clogged with lint. Improved venting and regular vent cleaning can therefore reduce appliance service calls and/or occupant complaints.

Implementation

A dryer must remove over four litres of water from a full load of clothing. To avoid moisture and mildew problems in the suite or laundry room, dryers must be vented to outside. The venting system is also intended to expel any lint that is not trapped by the dryer's lint filter. A venting that does not work well will trap lint. This reduces airflow, slows down the drying action and increases dryer runtime. It may also create a serious fire hazard. To determine if you need to improve dryer venting, follow these steps:

1. Investigate the dryer ducting. Any of the following types of ducting should be replaced:
   - Flexible plastic or vinyl duct is unacceptable. It is not recommended by manufacturers (and will void some warranties), and is prohibited by many municipalities as a fire hazard.
   - Thin foil flexible duct is substandard. Like the plastic duct, its pleats create turbulence, trapping moisture and lint.
   - Duct less than 10 cm in diameter is too restrictive to the airflow requirements of most dryers.
   - Crimped, bent or partially crushed ducting should be replaced.
2. Measure the length of the duct. Add 1.5 metres for every 90-degree elbow. Add 0.75 metres for every 45-degree elbow. If the total is greater than 7.5 metres, the venting should be rerouted. (If a shorter duct run is impossible, a booster fan may be added if air flow from the dryer seems low.)
3. Investigate the vent inlet and outlet. The vent hood should be at least 10 cm x 10 cm.
4. The dryer vent should be ducted directly outdoors. Sometimes multiple dryers are connected to a central mechanical ventilation system.
5. The vent should not empty into an unheated space such as an attic or crawl space.
6. Unplug the dryer before starting work.
7. If there is a booster fan in the duct, check it to make sure it is working. It should operate when the dryer is activated. There may be a delay if the booster fan is activated by an airflow or heat sensor. Disconnect the power and clean the fan blades and housing.
8. Check the lint trap for cleanliness and holes. There is one lint trap inside the dryer door and there may be another in the dryer vent.
9. Remove one of the panels (top, front, or back, whichever is easiest) from the dryer and use a flashlight to check the inside for lint build-up. If lint has accumulated, use a vacuum cleaner to remove it. You may find it necessary to remove other panels to reach different parts of the cabinet. Examine the door seals at the front of the cabinet—lint in the cabinet may indicate they are worn and should be replaced.
10. Replace the panels.
11. Detach the vent from the back of the dryer and use a flashlight to check it for lint. If the duct run is short, use a vacuum cleaner to remove any lint. If dryer ducts in the building are too long, and there are signs of heavy lint build-up, have them professionally cleaned.
12. Reattach the vent and plug the dryer back in.
13. Check duct insulation. Insulate any part of the duct that passes through an unheated area. Otherwise condensation on the inside of the duct will cause lint to stick and could cause water damage. The duct should be insulated and provided with a vapour barrier covering to a point two to three metres back from the exterior wall.
14. Check the duct joints to ensure they are well sealed. If not, seal the joints with duct mastic or metal foil tape.

15. Check the exterior wall damper at the vent outlet. It should have a hood or and a back draft damper to keep out weather and wildlife. No wire screen should be used, because it will trap lint unless it is accessible for cleaning. Clean the vent outlet using a vacuum cleaner.
16. Dryer vents—even good ones—may clog up with time. To improve safety and efficiency, consider establishing a pattern of inspection every 6 to 12 months, with vent cleaning as required.
17. If the dryers vent to a central dryer exhaust system, inspect the vent system ducting for lint build-up and have it cleaned if necessary. Also check the condition of the exhaust fan as it could be covered in lint as well. If the central dryer venting system operates continuously, consider controlling its operation with a timer so that it only operates when clothes dryers are in use.

Washer Replacement

Clothes washer technology has improved significantly in recent years. The Energy Star top-loading washers and the new front-loading washers save both water and energy. Furthermore, their faster spin speeds allow them to remove more water from the clothes. This reduces runtime in the dryer and saves dryer energy. Expected lifetime of a washer is usually 15 to 20 years. If your occupants' or common area washers are approaching this age, it may be time for replacing them in any case. Early replacement will save energy and avoid emergency service calls.

Cautions

- Check local building codes to ensure any new venting complies with requirements.
- Be sure to follow instructions about materials, maximum duct run, elbows and joints, to ensure that the vent will have good airflow and not trap lint.
- When sliding the dryer across a finished floor, it is best to protect the floor from damage. Appliance slides are available, but you can also use a scrap piece of vinyl flooring or a clean piece of plywood.

Where to Turn

Building maintenance staff can install dryer venting. Alternatively, you may want to hire contractors to do the work, particularly if the project involves a significant number of vents. HVAC or sheet metal installers could undertake the work, but you should check what materials they intend to use: foil or plastic flexible venting should be rejected.

Many duct cleaning services will clean dryer ducts. They may also be qualified to install new ducts. Again, be sure they plan to use the proper materials.

7. Other Systems

This section explains how to tune up the other systems in your building, which may include any or all of the following:

- Pools and spas
- Water supply pressurization systems
- Sewage pumping systems
- In-suite plumbing

7.1 Pools and Spas

If your building has a pool or a spa, it is likely a major energy user at your facility. Outdoor pools include pumping, filtration, and chemical treatment systems. Often they include heating and lighting systems as well. A heated outdoor pool is a large energy consumer. Typically 70 per cent of this energy use is from evaporation. Using a pool cover when the pool is not open can save as much as 50 per cent of the energy costs due to evaporation. Windbreaks near the pool can help reduce evaporative losses when the pool is open.

Indoor pools usually use even more energy annually than outdoor pools, because they are used year-round and do not benefit from solar gain. As with outdoor pools, 70 per cent of their energy use is due to evaporation. Using a pool cover when the pool is not in use can reduce the evaporation losses by 50 per cent.

Other energy efficiency measures to consider for both outdoor and indoor pools include solar heating, high efficiency pool heaters, and efficient pumps and pump motors.

Procedure		System
O-1	Pool Operation Tune-up	Indoor and Outdoor Pools

7.2 Pumping Systems

Your building may include one or more of the following pumping systems:

- a water pressure boosting system;
- a sewage pumping system;
- a domestic hot water circulation pump;
- a swimming pool pump;
- a sump pump.

Each pumping system includes the pump itself, a motor to drive it, and some controls. Tuning up these pump systems is similar to the procedure for DHW circulation pumps. Refer to Procedure DHW-4 for further information.

7.3 In-suite Plumbing

Hot and cold water use in the suites can be reduced through tune-ups of the following plumbing fixtures:

- toilets,
- showerheads; and
- faucet aerators.

Procedure		System
O-2	Toilet Tune-up	Suites
O-3	Showerheads and Faucet Aerators	Suites

Procedure O-1: Pool Operation Tune-up

Description

Tune-up a swimming pool by using a pool cover, keeping pool heaters and pumps regularly maintained, using efficient lighting, and running the pool efficiently.

Benefits

- The tune-up steps above can save up to 50 per cent of the energy used for the swimming pool at your building. Savings for a 50 m^2 indoor pool may be as much as $1,000 per year. The pool cover provides the largest share of these savings.
- Pool covers reduce evaporation losses and decrease the need for make-up water and water treatment chemicals. In an outdoor pool, it will also reduce cleaning time by preventing dirt and debris from entering the pool when the cover is in place. In an indoor pool, the cover will decrease the build-up of humidity in the pool room, reducing the cost of ventilation and conditioning outside air.

Implementation

If your building has either an outdoor or indoor pool, it is likely to be a big energy consumer. About 70 per cent of the heat loss from a pool is from evaporation. In an outdoor pool, this heat loss either adds to the cost of heating the pool or (if the pool is unheated) shortens the swimming season. In an indoor pool, the evaporation not only adds to the cost of heating the pool itself but must also be removed from the pool room by a ventilation system, further increasing the cost. Indoor pools generally use more energy than outdoor pools, mainly because they are used year round.

To tune up your swimming pool, follow these steps:

1. Use a pool cover when the pool is not in use. This is the single most effective step you can take to reduce pool heating costs.
2. For an outdoor pool, consider adding trees, shrubs, or fences to provide a windbreak. A 10 km (6.2 mph) wind can nearly quadruple the heat loss from the pool. Ideally, the windbreak should be as close as possible to the pool without blocking the sun, dumping leaves in the pool, or causing problems with roots.
3. Tune up the pool heater annually. Pool heaters are simpler than domestic water heaters, because they do not include a storage tank. Nonetheless, the procedures for tuning up DHW Tank Heaters provided in Section 5 can provide guidance.
4. Install screw-in compact fluorescent lamps thoughout pool change rooms and service areas where possible. See procedure El-2 in Section 6 for further guidance.
5. Tune up the pool pump and motor annually. Refer to procedure DHW-4 in Section 5 for further guidance.
6. Reduce water heating costs in the shower area by reducing shower temperatures to 35°C. This not only lowers energy costs, but also reduces people's showering time, producing further savings.
7. Tune up the water heater for the shower area annually. Refer to the procedures for tank water heaters in Section 5 for further guidance.
8. Install low-flow showerheads and aerators. Refer to Procedure O-3 for further information.

9. Tune up the toilets in the pool washrooms. Refer to Procedure O-2 for further information.
10. If the pool is heated, consider carefully the temperature you maintain. A 1/2°C rise in temperature can increase pool heating costs by nearly 10 per cent. For active swimming, about 26°C (78-80°F) is appropriate. For general use, about 28°C (82-84°F) is appropriate.
11. If the pool is not going to be used for several days, turn the temperature down or turn the heater off. Experiment to determine how long it takes to bring the pool back up to temperature.
12. Keep intake grates clear of debris. Clogged drains make the pump work harder.
13. Don't backwash the filter more frequently than necessary as this wastes water.
14. For an indoor pool, seal the building envelope in the pool area. Refer to procedure En-5 in Section 2 for further guidance.

Cautions

- Pool covers need to be managed properly for safety. They must be completely removed before anyone enters the pool.
- If you decide to set back the water temperature or turn off the pool heater when the pool is unused for several days, be sure to experiment and find out how long it takes to heat back up. Depending on how much it cools down, it may take many hours for the pool heater to return it to normal temperature.

Where to Turn

Building maintenance staff can do most of the tasks described above. For assistance with installing a pool cover, look under swimming pool contractors and dealers in the phone book.

Several of the steps above refer to other procedures in this manual. Further information on where to turn for help with those steps can be found under those procedures.

Procedure O-2: Toilet Tune-up

Description

Tune up the toilets in the suites by replacing the valve assembly components as needed.

Benefits

- Tuning up toilets will reduce the waste of water through leakage. A leaky toilet can waste enough water in one year to fill a backyard swimming pool.
- Tuned up toilets will also work better and more reliably, reducing service calls from unhappy occupants.
- Occupants will also benefit from reduced leakage noise and less need to jiggle the toilet handle to stop the toilet from filling continuously.

Implementation

You can rejuvenate a toilet by replacing the components in the tank. This will improve the function of the toilet, reducing the likelihood of service calls, and will also reduce wasted water caused by seals leaking or toilets continuously running. To tune up a toilet, follow these steps:

1. Interview the occupants to help assess the condition of the toilet. If they have heard the sound of water running, even briefly, when the toilet has not been flushed, the flapper valve is likely leaking. This can be tested by putting a few drops of a non-staining dye (such as food-colouring) in the tank. If the colour has appeared in the bowl after 10 minutes, the flapper valve leaks and should be replaced. Be sure the flapper replacement is suitable for the type of toilet otherwise it could leak as well.
2. Flush the toilet to find out how smoothly the tank components work. If the toilet fills slowly, replace the fill valve and the water supply connector. If water continues to run into the overflow after the tank is full, the fill valve requires either adjustment or replacement.
3. Examine the flush lever. If it is corroded, or if it catches on other components of the tank, replace it.
4. Purchase new tank components as required. A new fill valve, flapper, tank/lever handle, and water supply connector can be purchased separately or in kits. Consult your hardware store to ensure you have the right components to fit the model of toilet. The wrong flapper valve can cause more leakage or problems with flushing.
5. The valve to shut off the water supply to a toilet is usually located below the tank, on a pipe emerging from the wall behind the toilet. Turn it off by turning it clockwise. If the valve is not a ball valve, consider replacing it with a ball valve when the toilet is replaced.
6. Remove the tank top.
7. Flush the toilet to empty the tank and sponge out the remaining water.
8. Protect the floor below the tank with rags or newspapers.
9. Use a wrench or pliers to disconnect the old water supply connector. The water supply connector is usually a hose, but on very old toilets may be a small pipe. Disconnect it from both the supply pipe emerging from the wall or floor and from the end of the fill valve at the bottom of the tank.
10. The fill valve is attached to the bottom of the tank by a locknut underneath the tank. Use a wrench or pliers to remove it.

11. Your new fill valve will come with installation instructions. Position it in the tank as directed, making sure the washers are correctly positioned, and tighten the new locknut as directed.
12. Follow the installation instructions to connect the new water supply connector.
13. Remove the old flapper valve from the base of the overflow pipe. Follow the installation instructions for the new flapper valve to install it. Make sure it opens and closes smoothly.
14. Connect the refill tube on the fill valve to the top of the overflow pipe, as directed in the installation instructions.
15. The flush lever is attached to the front of the tank using a locknut on the inside of the tank. Undo the locknut using a wrench.
16. The new flush lever may need to be bent to fit the tank properly. Either bend it to match the old flush lever, or test it in the tank and bend it as needed. Bend it slowly and carefully, so it does not snap. If the new flush lever is too long, trim it with a hacksaw.
17. Remove the locknut from the new handle, insert the lever into the hole, slide the locknut over the lever, and tighten.
18. Connect the flapper chain from the lever to the flapper valve. Chain should have slight slack when in closed position. Trim off excess chain.
19. Clear any sand and rust from the system by:
    a. Removing the top of the fill valve (follow the installation instructions).
    b. Holding a container upside-down over the valve and turning the water supply on and off several times.
    c. Reinstall the top of the fill valve.
20. Adjust water level to the level marked on the inside of the tank by moving the float cup up or down, as directed in the installation instructions.
21. Using a small mirror, check the series of holes that sit under the rim of the bowl. These flush passages can get plugged up with mineral deposits or grime.
22. Carefully poke each hole clean with a length of wire clothes hanger. After cleaning all the passages, flush the toilet to remove loosened deposits. If necessary, repeat the process.

6-litre Toilets

Consider replacing high-volume toilets with the new 6-litre flush toilets. This will save water, defer capital expenditures at your municipal water and wastewater treatment plants, and be environmentally responsible.

Dual flush toilets are also very effective at saving water.

CMHC has supported Independent testing of 6-litre toilets. The results can be found on the CWWA website www.cwwa.ca

Cautions

- Toilets vary somewhat. Six-litre toilets, for example, have smaller tanks. Consult the staff at the retailer for assistance. If in doubt, buy parts for the first toilet and try them before ordering anything in quantity.

Where to Turn

Building maintenance staff can easily undertake this task. The parts can be purchased at any hardware store, or can be ordered in quantity from a plumbing supply store.

Procedure O-3: Showerheads and Faucet Aerators

Description

Reduce water consumption and water heating energy use by installing low-flow showerheads and faucet aerators.

Benefits

- The main benefit of this procedure is the energy savings associated with reduced hot water consumption. If water is heated electrically, one low flow showerhead can save over 200 kWh/yr.
- Water use can be reduced by as much as 50 per cent.
- The shower fixtures will look better.
- The procedure provides a good opportunity to check and repair leaks.

Implementation

After toilets, showerheads use the most water in homes, accounting for 17 per cent to 22 per cent of total indoor water use at a flow rate of 15 to 20 L/min. (4.4 U.K. gal. /min.). Kitchen or bathroom faucets typically account for 10 per cent to 15 per cent of indoor water use, with flow rates of 10 to 20 L/min. (2.2 to 4.4 U.K. gal. /min.). To install water conserving fixtures, follow these steps:

1. Correct any low pressure problems in the building before installing any flow reducing fixtures. Occupant complaints and frequent need to clean drain traps or sewers can be indications of low water pressure.
2. Check existing showerheads for maximum flow rate before deciding on new equipment. If maximum flow rate is already less than 13 litres/minute, the action is likely unnecessary. Shower flow rate can be determined using a stop watch to measure the time required to fill a bucket of known volume.
3. Select showerhead models carefully to ensure maximum user satisfaction. Consult with local water utility and energy supply companies. Water-saving showerheads have flow rates ranging from 6 to 13 L/min. (1.3 to 2.8 U.K. gal. /min.).
4. Involve occupants in the implementation of this procedure by conducting pilot tests of low flow fixtures. The effectiveness of low-flow showerheads varies between makes. It is important to ensure that the occupants will accept these fixtures before they are widely deployed.
5. Using a wrench, carefully remove the old showerhead from the fitting pipe. Forcing an older fixture that is corroded in place may damage pipe connections behind the wall, leading to expensive repairs. If the fixture is stuck, penetrating oil may be able to free it.
6. Install the new fixture by screwing it onto the fitting pipe.
7. A variety of flow regulators are available for faucets, usually with an aerator, to restrict maximum flow. If a threaded connection is present, a flow restrictor can also be added to the outlet of the faucet.
8. Have all leaks and drips repaired at the same time as installing the water saving devices, as this can save additional energy.

Fix Leaking Faucets

Water loss from a tap that leaks one drop per second is nearly 4,000 litres per year. At a sewage rate of $1.50/m^3, this is nearly $6/year. If leaking water is hot, the additional cost of wasted energy for water heating may be as much as $10/year.

Inspect faucets twice a year, and replace any leaking washers. Examine the washer seat when replacing the washer. If it is scored, grind it smooth or replace it. Typical cost of this work is approximately $5/fixture.

Washer-less (cartridge-type) faucets have less frequent failures, so they should be serviced as required and not included in a twice-yearly maintenance schedule. Ensure that replacement cartridges are available for the fixture you select.

Cautions

- Both aerating and non-aerating showerheads are effective at reducing water use. Aerating types, however, may create a cooler spray pattern and greater drafts that are often compensated for by the occupants increasing the ratio of hot to cold water, thus reducing potential hot water energy savings. Energy savings from non-aerating types tend to be superior.
- Product construction differs from all plastic (except the ball joint) to solid brass.
- Buildings with seniors may not achieve the same level of savings due to lower shower usage.
- Restrictors should not be put on utility sinks in laundries or service areas. The resulting slow fill of buckets/sinks can be a nuisance for users.

Where to Turn

Building maintenance staff can easily undertake this task. The parts can be purchased at any hardware store, or can be ordered in quantity from a plumbing supply store.

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