Tuning up the heating and cooling systems

Many MURBs in Canada are heated with baseboard systems, with electric baseboards somewhat more common than hydronic baseboards. 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 document, electric baseboard, with or without window air conditioners, is referred to as a system HC Type A. Hydronic baseboard, with or without window air conditioners, is referred to as a system HC Type B.

Other systems that are sometimes found include the following:
- 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)
### Procedures

1. Tune up electric baseboard heaters *(HC Type A)*
2. Tune up hydronic baseboard heaters *(HC Type B)*
3. Tune up boiler system *(HC Type B and C)*
4. Tune up a fan-coil unit *(HC Type C)*
5. Tune up air-conditioning chiller *(HC Type C)*
6. Tune up condenser *(HC Type C)*
7. Tune up cooling tower *(HC Type C)*
8. Tune up unit heater *(All types with garages)*
9. Tune up room air conditioner *(HC Type D)*
10. Tune up PTAC *(HC Type F)*

### 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 of up to 10%.
1. **Tune up 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 15 cm (6 in.) in depth and are installed along the bottom of the 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 grille. 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 the 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 attachment 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 3 of the Building Envelope Systems module 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 (that is, 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 a steady room temperature, causing occupants to adjust them upward. 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.
6. **Reset thermostat setpoint.** Adjust the thermostat setting to the 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.
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 grille. 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 air flow through the baseboard) by up to 80%.

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 the 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 exchanger surfaces, remove the enclosure and carefully vacuum the coil with the dusting or extender attachment 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 3 of the Building Envelope Systems module 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 (that is, direct sunlight from a nearby window). Check pipe-mounted thermostats for leaks.

4. **Calibrate the thermostat.** Older thermostats often lose their ability to maintain a steady room temperature, causing occupants to adjust them upward. 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 (0.9°F).
5. *Reset thermostat setpoint.* Adjust the thermostat setting to the 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 air flow over the fin tube. If there are complaints of overheating, the damper can be adjusted to reduce air flow 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.
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 thermal efficiencies range between 75 and 80%, but can fall to 50% 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 performed by a qualified contractor. Such tune-ups are described to familiarize property owners and managers, 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 indoor comfort and fewer complaints.

Implementation
Buildings with central fuel-fired hot water heating 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 distribution system.

Boiler service should be undertaken by a qualified tradesperson. Unless building staff members 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 members 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 louvres.

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 causes inefficient fuel combustion. Partially or fully obstructed, vents can also represent a safety hazard.
3. **Check water treatment.** Check to ensure that the proper water treatment process is being used to minimize scale buildup 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.** A buildup of internal scale and/or external 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 O₂, CO, CO₂, 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 specification, have the following corrective actions taken to improve combustion and heat transfer efficiency:

   a) Clean the burners.

   b) Clean the fire side of the heat exchanger.

   c) Descale the water side of the heat exchanger.

   d) For natural draft gas-fired boilers, adjust the draft regulator and/or fuel pressure in the manifold. For oil-fired boilers, check for proper oil pump operation. Replace the nozzle annually.

   e) For forced draft boilers, adjust the fuel-air ratio.

   f) Ensure the combustion air grille is clean and 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 indoor-outdoor temperature control to automatically reset the supply water temperature from the boiler in inverse proportion to the outdoor temperature. The building load rises with falling outside temperature, so controls should raise the boiler supply water temperature in inverse proportion. 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 (5°F) and 6°C (10°F). In addition, the setpoints of multiple boiler installations should be sequenced by 3°C 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 4 in the Domestic Hot Water Systems module for further information.

12. **Turn down thermostats.** Thermostats located in common areas, storage rooms, garages, etc. should be lowered as much as possible 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 overheated and/or underheated areas, consider having the balancing redone.

15. **Lime buildup.** Lime buildup inside the distribution piping can restrict hot water flow. Replace this piping as soon as possible.

### 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.
- **The 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 the 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 the Building Envelope Systems module for further information).**

### 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 setpoints. The temperature setpoints 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.

### Where to turn

Boilers should be serviced by a qualified tradesperson.
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-coil units 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

The tune-up of fan-coil systems involves 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 unit 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 the 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 buildup 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 the manufacturer’s recommendations. Dirty air filters restrict air flow and, consequently, reduce heating and cooling capacity and performance, and increase fan-coil unit 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 coil and carefully vacuum it with the dusting or extender attachment 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 the condensation pans located under the chilled water coils are clean and properly sloped to drain properly, and that the drain pipes are clear. Pour one 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 unit or in the supply air plenum leading from, or the return air plenum leading to, the fan-coil unit. The duct lining can become damaged and deteriorated over time and become an indoor air quality concern. The 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 louvres.** Vacuum dust and dirt off the vanes of the grilles and louvres.
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 is located away from any direct source of heat (that is, direct sunshine).
- Older thermostats often lose their ability to maintain a 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 (0.9°F).
- 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.
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-coil units 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 members 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 members 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

1. **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
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- Chilled water return temperature. Changes in the recorded pressures and temperatures can signal problems with decreased efficiency as a result of:
  - scaling or dirt accumulation in the condenser or the evaporator;
  - low water flow rate from clogged strainers or faulty pump operation; and
  - refrigerant leaks.

Modest changes in pressures and temperatures may also occur because of the 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. A 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 centre 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, therefore 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°C to 4°C (3°F to 7°F) 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) is only needed during peak summer periods. During mild weather at lower outside air temperatures, the condenser water temperature 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 (below 24°C or 75°F) for centrifugal chillers. These concerns are related to potential internal lubrication problems.

Where to turn

Chillers should be serviced by qualified contractors (for example, 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.
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 given 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 members 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 members 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 louvres. 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 the 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.
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; and
- controls.

The controls include a three-way control valve to maintain a fixed-return water temperature, temperature sensor 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 buildup. Similarly, periodic blowdown (forced drainage) is required to remove minerals and chemicals that 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 members 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 members 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 air flow rate can also reduce the heat rejection capacity. To ensure proper air flow, 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 and promote corrosion, scale buildup 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% of water flow is typically adequate to maintain acceptable water quality. The need for higher bleed-off rates could indicate a problem with the water treatment feed and controls.

5. Other operational checks. Additional operational inspections that should be carried out include:
   - inspecting the catch basin float assembly; and
   - verifying that the overflow drain is clear.

6. Reset condenser water temperature. Typical entering condenser water temperature of 29°C (85°F) is only needed during peak summer periods. During mild weather at lower outside air temperatures, the 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.
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 the 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 buildup
Corrective repairs, cleaning and adjustments will improve fan efficiency.

6. **Clean and comb the coil.** When the 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 a steady room temperature, causing occupants to adjust them upward. 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 in temperatures is greater than 0.5°C (0.9°F).
   - Unit heaters are often used in indoor garages or service rooms. Thermostats in these spaces should typically be set no higher than 15°C (59°F).

### 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.
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 3 in the Building Envelope Systems module 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 louvres.** Fans and air louvres should be cleaned periodically to maintain system efficiency. Dust buildup on fan blades and louvres decreases air flow, 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 the manufacturer’s recommendations. Loaded air filters result in a restriction of air flow 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 attachment 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 setpoint to the higher acceptable level during occupied periods.
    - Older thermostats often lose their ability to maintain a steady room temperature, causing occupants to adjust them upward. 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 (0.9°F).
    - Check and adjust the fan speed control (if applicable) to the minimum necessary to meet the load requirements.
    - Adjust the louvres 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.
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 louvre, 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 the 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 3 in the Building Envelope Systems module 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 louvres.** Fans and air louvres should be cleaned periodically to maintain system efficiency. Dust buildup on fan blades and louvres decreases air flow, 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 the manufacturer’s recommendations. Loaded air filters result in a restriction of air flow, 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 attachment 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 (that is, direct sunshine).
   - Older thermostats often lose their ability to maintain a steady room temperature, causing occupants to adjust them upward. 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 (0.9°F).
   - Adjust the thermostat setpoint 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.
Other Publications About Multi-Unit Residential Buildings

### Multi-Unit Residential Buildings – Tune-Ups for Energy and Water Efficiency Series
- Building Envelope Systems (OPIMS 69067)
- Domestic Hot Water Systems (OPIMS 69069)
- Electrical Systems (OPIMS 69072)
- Heating and Cooling Systems (OPIMS 69074)
- Other Water Systems (OPIMS 69076)
- Ventilation Systems (OPIMS 69078)

### Multi-Unit Residential Buildings – Energy and Water Efficiency Series
- Heating and Ventilation Systems (OPIMS 68752)
- Lighting Systems (OPIMS 68754)
- Building Envelope (OPIMS 68756)
- Domestic Hot Water (OPIMS 68758)
- Renewable Energy (OPIMS 68760)
- Electrical Systems (OPIMS 68762)
- Water Conservation (OPIMS 68764)

**Energy and Water Efficiency in Multi-Unit Residential Buildings: A User Guide for Property Managers and Owners** (OPIMS 68979)

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