

MULTI-UNIT RESIDENTIAL BUILDINGS

Tune-Ups for Energy and Water Efficiency

BUILDING ENVELOPE SYSTEMS

This document is a tool to help reduce energy and water costs and improve comfort in a 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 [MURBs]). A comprehensive tune-up can cut energy and water costs by 20%. A comprehensive tune-up would include the building envelope, heating and cooling systems, lighting and appliances, domestic hot water systems and other systems.

This document will:

- *suggest opportunities to tune up systems and equipment—along with more detail as to what the tune-ups involve and whether or not a contractor should be hired;*
- *describe the benefits of tune-up procedures; and*
- *offer some tips on additional actions to consider, including cost-effective retrofit opportunities.*

This document will not:

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

This document is intended as a guideline only and is not intended to replace professional advice.

Tuning 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
- Precast 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.

Procedures

- 1 Seal the bottom of the building** *(all system types)*
- 2 Seal the top of the building** *(all system types)*
- 3 Seal outside wall and openings** *(all system types)*
- 4 Seal vertical shafts** *(all system types)*
- 5 Compartmentalize service areas** *(all system types)*

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.

Starting the building tune-up with the envelope makes sense for the following reasons:

- 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 mould and mildew growth while improving comfort.
- The building will last longer because less moisture will be carried into the wall and roof structures.

Finding air leakage

When assessing the conditions 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 door testing. 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.

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. Such air movement is a problem as apartments on the upwind side of the building can be drafty, while apartments on the downwind 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 overheating and odour transfer problems.

PROCEDURE

1 Seal the bottom of the building

Description

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

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.

■ 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 the condition of the weatherstripping around the doors. If necessary, continue as indicated in the following steps.
3. Install a high-quality polyethylene-clad foam compression seal onto the doorstop.
4. Install a single metal holder and a fin-and-pile door sweep on the exterior and interior faces of the door.
5. Seal around the door closer and lock with a polyethylene-clad, V-shaped foam gasket on the edge of the stop (not the face).
6. Caulk the 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 the gap between the vent and the 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. Reweatherstrip 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 a vertical drywall bulkhead from top to 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 the exterior perimeter of the 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 a high-quality polyethylene-clad foam compression seal onto the doorstop.
18. Install a single metal holder and a fin-and-pile door sweep on the exterior and interior faces of the door.
19. Seal around the door closer and lock with a polyethylene-clad, V-shaped foam gasket on the flange between the two doors.
20. Caulk the 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/weatherstripping 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 garage 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 the surrounding ceiling finish.

■ Weatherstrip inspection hatches

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

■ Seal walls between parking garage and core of building

- 28. Gaps and cracks may exist where the walls separating the underground parking garage areas from the core of the building meet. The walls may be penetrated by ducts, wiring and pipes.
- 29. Depending on the size of the gap between the partition wall and the 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 the fire-stop mortar.

Cautions

- This procedure will tighten your building. Ensure that the building is properly ventilated. Refer to the Ventilation System module 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 the 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

2 Seal the top of the building

Description

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

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-ups 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.

■ Seal roof-wall intersections

1. Where possible, access the ceiling or roof space on the top floor of the 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, do the following:

3. Inject two-component polyurethane foam sealant between the flutes of the steel decking and the top of the wall.
4. Drill flutes as near as possible to the outside walls and inject foam into the 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 a high-quality polyethylene foam compression seal onto the doorstop.
7. Install a single metal holder and a fin-and-pile door sweep on the exterior and interior faces of the lower edge of the door.
8. Seal around the door closer and lock with a polyethylene-clad, V-shaped foam gasket on the edge of the stop (not the face).
9. Caulk the 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 the outside are evident—in which case the cracks can be sealed with caulking.
12. If the penthouse has metal siding, seal the edges of the flange to the floor and roof with caulking or one-component polyurethane foam sealant (depending on the size of the 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 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 louvers and lubricate and adjust to ensure they close tightly.
16. Check louvers; repair or replace damaged items.
17. Reweatherstrip louvers where necessary with closed-cell neoprene foam gaskets.
18. Reweatherstrip the garbage chute vent caps and gasket the operable top hatch.
19. Reweatherstrip the 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 the Ventilation System module for information on tuning up your 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 walls, ceiling and floor assemblies are approved for use in such applications.

Where to turn

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



PROCEDURE

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 fans, sleeves of packaged terminal air conditioners (PTACs) or air conditioners and other penetrations.

Benefits

- Energy efficiency
- Comfort
- Durability
- Health
- Safety

Implementation

Procedures 1 through 3 will help to reduce uncontrolled infiltration into, and air movement through, the building as a result of the stack effect. The next task is to improve the airtightness of outside walls, primarily in suites. This will further improve energy efficiency, but perhaps, more importantly, it 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 to the occupants.

■ 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 a single metal holder and a fin-and-pile door sweep on the exterior and interior faces of the door.
4. Seal around the door closer and lock with a polyethylene-clad, V-shaped foam gasket on the edge of the stop (not the face).
5. Caulk the front edge of both metal holders—for compression gasket and fin-and-pile door sweep.
6. Seal the door frame to the surrounding wall with paintable siliconized latex caulk.



■ Seal window trim

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

■ Seal and insulate behind baseboard heaters

12. *Ensure power to the 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 or grease and remove debris.
15. Seal any wall penetrations (for electrical services) and the gap between the drywall and the floor with a one-component polyurethane foam sealant (or caulk depending on the size of the gap).

■ Seal PTAC and air conditioner sleeves

16. Ensure that the air conditioner is levelled according to the 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 in.) 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 prefinished 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 the unit and the sleeve, and between the sleeve and the 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 the perimeter of the 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 junction

27. Remove baseboard.
28. Seal gap between the drywall and the floor with one-component polyurethane foam sealant.
29. Replace baseboard using silicone caulk as adhesive.
30. 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 the Ventilation Systems module 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 the building staff. If you have any concerns about safety or knowledge of how to carry out the work correctly, hire an air leakage control contractor to do the work.



PROCEDURE

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

- 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 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.

■ Weatherstrip fire doors in the stairwell

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

■ Seal plumbing, electrical, cable and other wall, floor, 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. (The system must comply with ULC-/ULI-rated assemblies.)



■ Reduce size of cable holes into elevator machine room

8. Reduce the gap between the elevator cables and wiring and the adjacent floor area to a maximum of 1.2 cm (½ in.) around the cables.
9. Use sheet metal to reduce the clearance between the floor slab and the cables.
10. Fasten the sheet metal to the floor slab using screws. Then caulk the perimeter to the floor.

■ Seal bus bar openings

11. Seal the perimeter using a 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 the garbage chute hatch to the surrounding chute housing.
13. Use siliconized latex caulk to seal the chute housing perimeter to the wall.

■ Seal corridor ventilation grille perimeters

14. Remove grille.
15. Seal any gap between ducting and the 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 the floor/ceiling slabs, use one- or two-component polyurethane foam sealant as backing to fire-stop mortar.

Cautions

- This procedure will reduce air movement through your building. Ensure that the building is properly ventilated. Refer to the Ventilation System module 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 the building staff. If you have any concerns about safety or knowledge of how to carry out the work correctly, hire an air leakage control contractor to do the work.



PROCEDURE

5

 Compartmentalize service areas

Description

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

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 3, sealing the openings to the rest of the building will further reduce 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 room
- 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



■ Weatherstrip all steel access doors into the building interior

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

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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)

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- *Heating and Ventilation Systems* (OPIMS 68752)
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