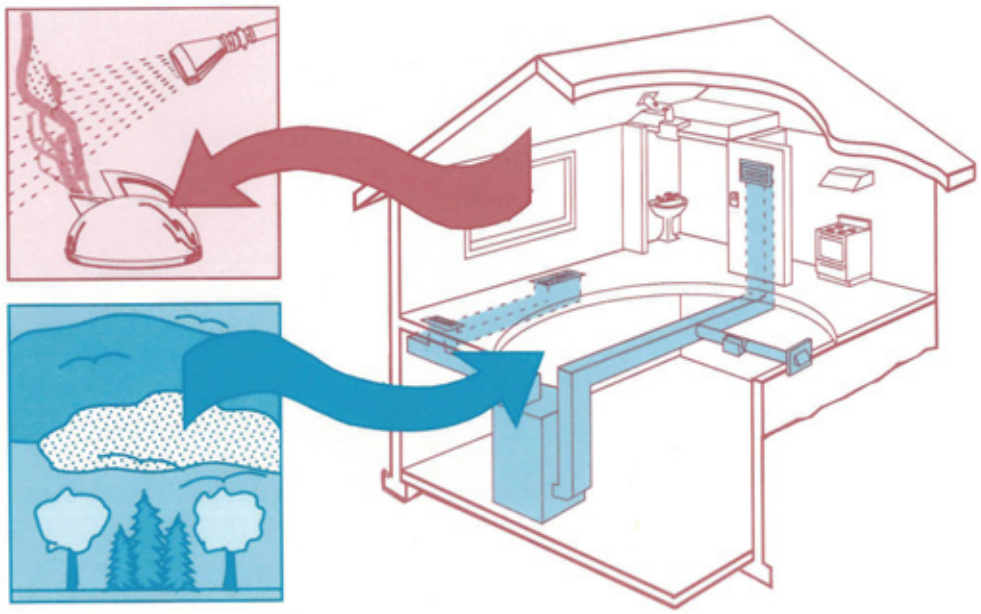
COMPLYING WITH RESIDENTIAL VENTILATION REQUIREMENTS

In the 1995 National Building Code



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COMPLYING WITH

RESIDENTIAL VENTILATION REQUIREMENTS

IN THE 1995 NATIONAL BUILDING CODE

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Complying with Residential Ventilation Requirements in the 1995 National Building Code is not a substitute for the National Building Code. The administration of building code requirements is a provincial responsibility. Local ventilation requirements may differ from those of the National Building Code. Therefore, compliance with the National Building Code does not necessarily constitute compliance with provincial requirements. The legislation which must be referred to in matters related to technical interpretation and code enforcement are the appropriate provincial building codes.

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PREFACE

All dwellings require fresh air to deal with moisture, odours and indoor pollutants. The 1995 National Building Code (NBC) requires that new dwellings have mechanical ventilation systems capable of providing this fresh air.

Canada Mortgage and Housing Corporation has prepared this manual to help house builders understand the NBC ventilation requirements. Performance, reliability or safety testing has not been done on all the systems (options #2 and #5). As such, their inclusion in this manual does not constitute an endorsement. These designs have been included because they are permitted by the NBC.

The people who contributed directly to the preparation of this manual are identified in the Acknowledgements at the beginning of this manual. They contributed considerable time and energy. But, with your help, this manual can be improved.

If you have suggestions for clarification and/or improvements which would make future editions more useful to you, please send them to:

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LIMITATIONS

An improperly installed ventilation system may jeopardize occupant health and safety, or cause damage to the structure. Proper installation of residential ventilation systems requires an understanding of:

- fuel-fired appliance codes;
- proper installation and operating procedures for combustion appliances, electrical wiring, electrical codes, controls wiring and ductwork;
- the principals and purposes of ventilation;
- operation of ventilation equipment;
- air flow measurement and balancing, etc.

This manual is intended for use by persons with this prerequisite knowledge.

BUILDER SUMMARY

The Builder Summary is an overview of the ventilation requirements for residential buildings falling under Part 9 of the 1995 National Building Code (NBC). Builder responsibilities for ensuring that a ventilation system meets the NBC are identified. Six ventilation systems which meet the Part 9 requirements are briefly summarized. (Detailed system descriptions are provided in the last section of this manual.)

Read the entire manual to understand fully the implications of the ventilation requirements for new dwellings. The Builder Summary and the balance of this manual are not meant to replace the specific requirements of the NBC. In the event of a perceived conflict between this document and the NBC, the interpretation of jurisdiction having authority will prevail.

CODE OVERVIEW

The 1995 National Building Code requires the installation of a mechanical ventilation system in most new dwelling units. These ventilation systems must be installed in accordance with the prescriptive requirements of NBC Section 9.32 Ventilation, or CAN\CSA-F326 "Residential Mechanical Ventilation Systems".

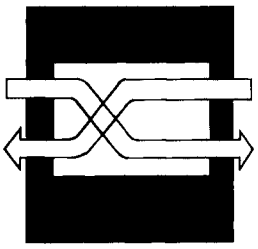
A knowledgeable ventilation system installer can select and install one of the Part 9 ventilation system options described in this manual, or custom design and install a ventilation system (provided that it complies with the prescriptive requirements of Section 9.32 or with the requirements of CAN\CSA-F326 "Residential Mechanical Ventilation Systems").

DESIGN REQUIREMENTS

A residential ventilation system must be designed in accordance with Part 6 of the NBC if it serves more than one dwelling unit. Mechanical ventilation systems complying with Part 9 of the NBC must:

- be self-contained and serve a single dwelling unit;
- be capable of providing continuous ventilation at predetermined airflow rates;
- exhaust directly from all kitchens, bathrooms and water closet rooms;
- include a means of distributing outdoor air to certain areas of the house;
- use ventilation fans which meet specific sone (noise) ratings;
- provide make-up air systems for large exhaust devices if soil gas is deemed to be a problem or if a non-solid-fuel burning appliance vented through a chimney is present;
- provide CO detector/alarms in rooms with solid-fuel burning appliances if make-up air is not provided for large exhaust devices, or if solid-fuel burning appliances do not have doors that substantially close off the firebox.

HRVs AND ERVs



Over the past few years, "Heat Recovery Ventilator" and "HRV" have become the generic terms used in the residential construction industry for factory assembled air-to-air heat exchangers complete with ventilation fans. The terms "Energy Recovery Ventilator" and "ERV" are also used because they better describe the function of these devices, especially when cooling and/or moisture transfer occurs. The terms Energy Recovery Ventilator and ERV include any device referred to as a Heat Recovery Ventilator or HRV.

VENTILATION SYSTEM OPTIONS

Two Ventilation System Decision Trees follow. The first, for houses that do not contain solid-fuel burning appliances, applies to most new houses. The second is for houses which contain solid-fuel burning appliances. The Ventilation System Decision Trees are intended to help the user decide which part of the NBC to apply and, where appropriate, which of the six ventilation system options to choose. One or more of these systems will meet the needs of most dwellings and owners. For greater flexibility than is afforded by these system options, a builder may develop a custom designed ventilation system, provided it satisfies the Part 9 requirements. The systems and equipment briefly described in this section are described in more detail in the sections that follow.

OPTIONS

OPTION 1

Outdoor air supply duct coupled to a forced air furnace return.

OPTION 2

Auxiliary supply fan coupled to a forced air furnace return.

OPTION 3

HRV coupled to a forced air furnace/ extended principal exhaust ductwork.

OPTION 4

HRV coupled to a forced air furnace/ simplified principal exhaust ductwork.

OPTION 5

Auxiliary supply fan not coupled to a forced air furnace.

OPTION 6

HRV not coupled to a forced air furnance.

1995 NBC VENTILATION SYSTEM DECISION TREE FOR HOUSES WITHOUT SOLID-FUEL BURNING APPLIANCES

If solid-fuel burning appliances is to be installed, do NOT use this decision tree

Is dwelling supplied with electric power?

Yes

Heating season (mechanical) ventilation is required.[1]
Is this a self-contained ventilation system serving a single dwelling unit?

Yes

Part 9 of the Code applies.
Select one of the system options described?

Yes

Is soil gas deemed to be a problem[2] and/or are non-solid fuel-fired appliance(s) vented through a chimney?

Yes

Provide make-up air for each device/system which mechanically exhausts more than 75 L/s.

Is ventilation system coupled to forced air heating system?

Yes

Choose Option 1,2,3 or 4

No

Choose Option 5 or 6

No

Design ventilation system in accordance with Part 6.

No

Prepare detailed design complying with CAN/CSA F326 or Section 9.32.

No to both

No

Mechanical ventilation is not required
Provide natural ventilation as per 9.32.1.2 and 9.32.2 of Code.

[1] Non-heating season ventilation is also required. It may be provided by natural or mechanical means, as described in Section 9.32.2.

[2] Soil gas is deemed to be a problem if the authority having jurisdiction has so designated it, and a soil gas mitigation system has not been installed.

1995 NBC VENTILATION SYSTEM DECISION TREE
FOR HOUSES WITH SOLID-FUEL BURNING APPLIANCES

Is dwelling supplied with electric power?

Yes

Heating season (mechanical) ventilation is required.[1]
Is this a self-contained ventilation system serving a single dwelling unit?

Yes

Part 9 of the Code applies.
Select one of the system options described?

Yes

Is soil gas deemed to be a problem[2] and/or are non-solid fuel-fired appliance(s) vented through a chimney?

Yes

Provide make-up air for each device/system which mechanically exhausts more than 75 L/s.

Install a CO detector/alarm in rooms with solid-fuel appliances that do not have doors which substantially close off the firebox.

Is ventilation system coupled to forced air heating system?

Yes

Choose Option 1,2,3 or 4

No

Choose Option 5 or 6

No to both

Are solid fuel-fired appliances with doors that substantially close off the firebox, and a device or system which exhausts more than 75 L/s, installed?

Yes

Provide make-up air systems or install a CO detector/alarm in rooms with solid fuel-fired appliances with doors that substantially close off the firebox.

No

No

Design ventilation system in accordance with Part 6.

No

Prepare detailed design complying with CAN/CSA F326 or Section 9.32.

No

Mechanical ventilation is not required
Provide natural ventilation as per 9.32.1.2 and 9.32.2 of Code.

[1] Non-heating season ventilation is also required. It may be provided by natural or mechanical means, as described in Section 9.32.2.

[2] Soil gas is deemed to be a problem if the authority having jurisdiction has so designated it, and a soil gas mitigation system has not been installed.

OPTIONS

OPTION 1
Outdoor air supply duct coupled to a forced air furnace return.

OPTION 2
Auxiliary supply fan coupled to a forced air furnace return.

OPTION 3
HRV coupled to a forced air furnace/ extended principal exhaust ductwork.

OPTION 4
HRV coupled to a forced air furnace/ simplified principal exhaust ductwork.

OPTION 5
Auxiliary supply fan not coupled to a forced air furnace.

OPTION 6
HRV not coupled to a forced air furnance.

Ventilation System Option 1

▪Outdoor Air Supply Duct Coupled to a Forced Air Heating System

SYSTEM DESCRIPTION

The principal exhaust fan, controlled by a centrally-located manual switch, draws exhaust air from the kitchen, bathrooms and/or other central location. Outdoor air is supplied to the furnace return air plenum through an outdoor air supply duct. The furnace circulation fan operates whenever the principal exhaust fan is on. Suction in the furnace return air duct created by operation of the furnace circulation fan draws outdoor air into the return duct, where it is mixed with house air and distributed through the heating system supply air ducts.

Make-up air systems are required for devices which exhaust more than 75 L/s (160 cfm) if soil gas is deemed to be a problem **or** if there are combustion appliances vented through a chimney. Exhaust devices which may require make-up air include clothes dryers, range hoods, central vacs and HRVs with unbalanced defrost cycles.

SYSTEM CHARACTERISTICS

- Simple.
- Low initial cost.
- No energy recovery, so the cost of ventilating may be high.
- May induce cool drafts which affect occupant comfort during the heating season.

BASIC COMPONENTS SPECIFICATION

ALL FANS ▪ Capacity ratings based on static pressure differentials of 50 Pa (0.2 in.W.G.) for in-line fans (ductwork attached to both sides); 25 Pa (0.1 in. W.G.) for ducted fans (ducts are connected only on one side of the fan); and 7.5 Pa (0.03 in.W.G.) for direct discharge fans (no attached ductwork). Otherwise, design using Section 9.33.

PRINCIPAL EXHAUST FAN ▪ Suitable for continuous operation. Sound rating of not more than 2.0 sones.

SUPPLEMENTAL KITCHEN EXHAUST (MAY BE REQUIRED) ▪ May be a range hood. Supplemental kitchen exhaust fans which meet part of the total ventilation capacity requirements must have a sound rating of not more than 3.5 sones.

SUPPLEMENTAL BATHROOM EXHAUST (MAY BE REQUIRED) ▪ Fan sound rating of not more than 2.0 sones if it is required to meet part of the total ventilation capacity requirements.

MAKE-UP AIR SYSTEM ▪ If handling untempered outdoor air, fans must be approved for such use. System may require an outdoor air pre-heater. May have to be custom designed and built. (At the time of publication, packaged make-up air systems for residential applications were not readily available.)

CARBON MONOXIDE DETECTORS/ALARMS ■ Required in each room with solid-fuel burning appliance that does not have doors which substantially close off the fire box. Must conform to CAN/CGA 6.19-M "Residential Carbon Monoxide Detectors".

CONTROLS ■ A centrally-located manual switch labelled "Ventilation Fan" operates the principal exhaust fan. The forced air heating system circulation fan is controlled to operate whenever the principal exhaust fan is operated. Supplemental exhaust fans are operated by a manual switch in each room served by the fan. Principal exhaust fans and supplemental exhaust fans may also be activated by automatic controls. Make-up air systems operate automatically when the device they serve is operated.

■ Ventilation System Option **2**

▪ Auxiliary Supply Fan Coupled to a Forced Air Heating System

SYSTEM DESCRIPTION

A principal exhaust fan, controlled by a centrally-located manual switch, draws exhaust air from the kitchen, bathrooms and/or other central location. An auxiliary supply fan in a duct between the outdoors and the furnace return air plenum supplies outdoor air to the furnace return duct. The furnace circulation fan and auxiliary supply fan operate whenever the principal exhaust fan is on. Outdoor air and house air are mixed and distributed throughout the house by the furnace circulation fan.

Make-up air systems are required for devices which exhaust more than 75 L/s (160 cfm) if soil gas is deemed to be a problem **or** if there are combustion appliances vented through a chimney. Exhaust devices which may require make-up air include clothes dryers, range hoods, central vacs and HRVs with unbalanced defrost cycles.

SYSTEM CHARACTERISTICS

- Simple.
- Low initial cost.
- No energy recovery, so the cost of ventilating may be high.
- May induce cool drafts which affect occupant comfort during heating season.
- Will not imbalance house pressures if properly set up.

BASIC COMPONENTS SPECIFICATION

ALL FANS ▪ Capacity ratings based on static pressure differentials of 50 Pa (0.2 in.W.G.) for in-line fans (ductwork attached to both sides); 25 Pa (0.1 in. W.G.) for ducted fans (ducts are connected only on one side of the fan); and 7.5 Pa (0.03 in.W.G.) for direct discharge fans (no attached ductwork). Otherwise, design using Section 9.33.

PRINCIPAL EXHAUST FAN ▪ Suitable for continuous operation. Sound rating of not more than 2.0 sones.

AUXILIARY SUPPLY FAN ▪ Suitable for continuous operation handling outdoor air. Sound rating of not more than 2.0 sones.

SUPPLEMENTAL KITCHEN EXHAUST (MAY BE REQUIRED) ▪ May be a range hood. Supplemental kitchen exhaust fans which meet part of the total ventilation capacity requirements must have a sound rating of not more than 3.5 sones.

SUPPLEMENTAL BATHROOM EXHAUST (MAY BE REQUIRED) ▪ Fan sound rating of not more than 2.0 sones if it is required to meet part of the total ventilation capacity requirements.

MAKE-UP AIR FANS ▪ If handling untempered outdoor air, fans must be approved for such use. System may require an outdoor air pre-heater. May have to be custom designed and built. (At the time of publication, packaged make-up air systems for residential applications were not readily available.)

CARBON MONOXIDE DETECTORS/ALARMS ■ Required in each room with solid-fuel burning appliance that does not have doors which substantially close off the fire box. Must conform to CAN/CGA 6.19-M "Residential Carbon Monoxide Detectors".

CONTROLS ■ A centrally-located manual switch labelled "Ventilation Fan" operates the principal exhaust fan. The auxiliary supply fan and the forced air heating system circulation fan are controlled to operate whenever the principal exhaust fan operates. Supplemental exhaust fans are operated by a manual switch in each room served by the fan. The principal exhaust fan and supplemental exhaust fans may also be activated by automatic controls. Make-up air systems operate automatically when the device they serve is operated.

Ventilation System Option **3**

- Heat Recovery Ventilator Coupled to a Forced Air Heating System/Extended Exhaust Ductwork

SYSTEM DESCRIPTION

An HRV, controlled by a centrally-located manual switch, draws exhaust air from the kitchen, bathrooms and/or other central location and supplies outdoor air to the furnace return air plenum. The furnace circulation fan operates whenever the HRV is on. Outdoor air and house air are mixed and distributed throughout the house by the furnace circulation fan. An HRV with a high speed/low speed control can meet both principal exhaust flow requirements and total ventilation capacity requirements without depressurizing dwelling.

Make-up air systems are required for devices which exhaust more than 75 L/s (160 cfm) if soil gas is deemed to be a problem **or** if there are combustion appliances vented through a chimney. Exhaust devices which may require make-up air include clothes dryers, range hoods, central vacs and HRVs with unbalanced defrost cycles.

SYSTEM CHARACTERISTICS

- HRV preheats outdoor air, reducing heating costs and improving occupant comfort.
- HRV includes supply and exhaust fans, and some controls.
- HVI (Home Ventilating Institute)-certified performance; full design data are readily available for many HRVs.
- HRV filters and core require routine maintenance.
- Costs more to install than system options 1 or 2.

BASIC COMPONENTS SPECIFICATION

ALL FANS ■ Capacity ratings based on static pressure differentials of 50 Pa (0.2 in.W.G.) for in-line fans (ductwork attached to both sides); 25 Pa (0.1 in. W.G.) for ducted fans (ducts are connected only on one side of the fan); and 7.5 Pa (0.03 in.W.G.) for direct discharge fans (no attached ductwork). Otherwise, design using Section 9.33.

HEAT RECOVERY VENTILATOR ■ Performance HVI-certified to CAN/CSA-C439, "Rating the Performance of Heat Recovery Ventilators".

SUPPLEMENTAL KITCHEN EXHAUST (MAY BE REQUIRED) ■ May be a range hood. Supplemental kitchen exhaust fans which meet part of the total ventilation capacity requirements must have a sound rating of not more than 3.5 sones.

SUPPLEMENTAL BATHROOM EXHAUST (MAY BE REQUIRED) ■ Fan sound rating of not more than 2.0 sones if it is required to meet part of the total ventilation capacity requirements.

MAKE-UP AIR FANS ■ If handling untempered outdoor air, fans must be approved for such use. System may require an outdoor air pre-heater. May have to be custom designed and built. (At the time of publication, packaged make-up air systems for residential applications were not readily available.)

CARBON MONOXIDE DETECTORS/ALARMS ■ Required in each room with solid-fuel burning appliance that does not have doors which substantially close off the fire box. Must conform to CAN/CGA 6.19-M "Residential Carbon Monoxide Detectors".

CONTROLS ■ Centrally-located manual switch labelled "Ventilation Fan" can operate Heat Recovery Ventilator at principal exhaust flow rate. Forced air heating system circulation fan is controlled to operate whenever the HRV is operating. Supplemental exhaust fans are operated by a manual switch in each room served by the fan. HRV and supplemental exhaust fans may also be activated by automatic controls. Make-up air systems operate automatically when the device they serve is operated.

Ventilation System Option 4

- Heat Recovery Ventilator Coupled to a Forced Air Heating System/Simplified Exhaust Ductwork

SYSTEM DESCRIPTION

An HRV, controlled by a manual switch, draws exhaust air from the furnace return plenum and supplies outdoor air to the furnace return air plenum. The furnace circulation fan operates whenever the HRV is on. Outdoor air and house air are mixed and distributed throughout the house by the furnace circulation fan. An HRV with a high speed/low speed control can meet both principal exhaust flow requirements and total ventilation capacity requirements without depressurizing dwelling.

Supplemental exhaust fans are installed in the kitchen and bathrooms.

Make-up air systems are required for devices which exhaust more than 75 L/s (160 cfm) if soil gas is deemed to be a problem **or** if there are combustion appliances vented through a chimney. Exhaust devices which may require make-up air include clothes dryers, range hoods, central vacs and HRVs with unbalanced defrost cycles.

SYSTEM CHARACTERISTICS

- Simpler to install than system option 3.
- HRV preheats outdoor air, reducing heating costs and improving occupant comfort.
- HRV includes supply and exhaust fans, and some controls.
- HVI (Home Ventilating Institute)-certified performance; full design data are readily available for many HRVs.
- HRV filters and core require routine maintenance.
- May cost more to install than system options 1 or 2.

BASIC COMPONENTS SPECIFICATION

ALL FANS ■ Capacity ratings based on static pressure differentials of 50 Pa (0.2 in.W.G.) for in-line fans (ductwork attached to both sides); 25 Pa (0.1 in. W.G.) for ducted fans (ducts are connected only on one side of the fan); and 7.5 Pa (0.03 in.W.G.) for direct discharge fans (no attached ductwork). Otherwise, design using Section 9.33.

HEAT RECOVERY VENTILATOR ■ Performance HVI-certified to CAN/CSA-C439, "Rating the Performance of Heat Recovery Ventilators".

SUPPLEMENTAL KITCHEN EXHAUST (REQUIRED) ■ May be a range hood. Supplemental kitchen exhaust fans which meet part of the total ventilation capacity requirements must have a sound rating of not more than 3.5 sones.

SUPPLEMENTAL BATHROOM EXHAUST (REQUIRED) ■ Fan sound rating of not more than 2.0 sones if it is required to meet part of the total ventilation capacity requirements.

MAKE-UP AIR FANS ■ If handling untempered outdoor air, fans must be approved for such use. System may require an outdoor air pre-heater. May have to be custom designed and built. (At the time of publication, packaged make-up air systems for residential applications were not readily available.)

CARBON MONOXIDE DETECTORS/ALARMS ■ Required in each room with solid-fuel burning appliance that does not have doors which substantially close off the fire box. Must conform to CAN/CGA 6.19-M "Residential Carbon Monoxide Detectors".

CONTROLS ■ Centrally-located manual switch labelled "Ventilation Fan" can operate Heat Recovery Ventilator at principal exhaust flow rate. Forced air heating system circulation fan is controlled to operate whenever the HRV is operating. Supplemental exhaust fans are operated by a manual switch in each room served by the fan. HRV and supplemental exhaust fans may also be activated by automatic controls. Make-up air systems operate automatically when the device they serve is operated.

■ Ventilation System Option **5**

▪ Auxiliary Supply Fan Not Coupled to a Forced Air Heating System

SYSTEM DESCRIPTION

A principal exhaust fan, controlled by a centrally-located manual switch, draws exhaust air from the kitchen, bathrooms and/or other central location. An auxiliary supply fan with a heater supplies outdoor air through a small-diameter duct system and high wall grilles to each bedroom, to any storey without a bedroom and, if there is no storey without a bedroom, to the principal living area whenever the principal exhaust fan is operated.

Make-up air systems are required for devices which exhaust more than 75 L/s (160 cfm) if soil gas is deemed to be a problem **or** if there are combustion appliances vented through a chimney. Exhaust devices which may require make-up air include clothes dryers, range hoods, central vacs and HRVs with unbalanced defrost cycles.

SYSTEM CHARACTERISTICS

- No energy recovery, so the cost of ventilating may be high.
- Auxiliary supply air must be preheated.
- Cool ventilation air may affect occupant comfort during the heating season.
- Will not imbalance house pressures if properly set up.

BASIC COMPONENTS SPECIFICATION

ALL FANS ■ Capacity ratings based on static pressure differentials of 50 Pa (0.2 in.W.G.) for in-line fans (ductwork attached to both sides); 25 Pa (0.1 in. W.G.) for ducted fans (ducts are connected only on one side of the fan); and 7.5 Pa (0.03 in.W.G.) for direct discharge fans (no attached ductwork). Otherwise, design using Section 9.33.

PRINCIPAL EXHAUST FAN ■ Suitable for continuous operation. Sound rating of not more than 2.0 sones.

AUXILIARY SUPPLY FAN ■ Suitable for continuous operation handling outdoor air. Sound rating of not more than 2.0 sones.

SUPPLEMENTAL KITCHEN EXHAUST (MAY BE REQUIRED) ■ May be a range hood. Supplemental kitchen exhaust fans which meet part of the total ventilation capacity requirements must have a sound rating of not more than 3.5 sones.

SUPPLEMENTAL BATHROOM EXHAUST (MAY BE REQUIRED) ■ Fan sound rating of not more than 2.0 sones if it is required to meet part of the total ventilation capacity requirements.

MAKE-UP AIR FANS ■ If handling untempered outdoor air, fans must be approved for such use. System may require an outdoor air pre-heater. May have to be custom designed and built. (At the time of publication, packaged make-up air systems for residential applications were not readily available.)

CARBON MONOXIDE DETECTORS/ALARMS ■ Required in each room with solid-fuel burning appliance that does not have doors which substantially close off the fire box. Must conform to CAN/CGA 6.19-M "Residential Carbon Monoxide Detectors".

CONTROLS ■ Centrally-located manual switch labelled "Ventilation Fan" operates the principal exhaust fan and the auxiliary supply fan. Supplemental exhaust fans are operated by a manual switch in each room served by the fan. The principal exhaust and supplemental exhaust fans may also be activated by automatic controls. Make-up air systems operate automatically when the device they serve is operated. A preheater warms auxiliary supply air to at least 12 °C.

Ventilation System Option **6**

- Heat Recovery Ventilator not Connected to a Forced Air Heating System

SYSTEM DESCRIPTION

An HRV, controlled by a manual switch, draws exhaust air from the kitchen, bathrooms or other central location and supplies outdoor air through a small-diameter duct system to each bedroom, to any storey without a bedroom and, if there is no storey without a bedroom, to the principal living area. An HRV with a high speed/low speed control can meet both principal exhaust flow requirements and total ventilation capacity requirements without depressurizing dwelling.

Make-up air systems are required for devices which exhaust more than 75 L/s (160 cfm) if soil gas is deemed to be a problem **or** if there are combustion appliances vented through a chimney. Exhaust devices which may require make-up air include clothes dryers, range hoods, central vacs and HRVs with unbalanced defrost cycles.

SYSTEM CHARACTERISTICS

- HRV preheats outdoor air, reducing operating costs and improving occupant comfort.
- HRV supplied with supply and exhaust fans, and some controls.
- HVI-certified performance; full design data are readily available for many HRVs.
- HRV filters and core require routine maintenance.

BASIC COMPONENTS SPECIFICATION

ALL FANS ■ Capacity ratings based on static pressure differentials of 50 Pa (0.2 in.W.G.) for in-line fans (ductwork attached to both sides); 25 Pa (0.1 in. W.G.) for ducted fans (ducts are connected only on one side of the fan); and 7.5 Pa (0.03 in.W.G.) for direct discharge fans (no attached ductwork). Otherwise, design using Section 9.33.

HEAT RECOVERY VENTILATOR ■ Performance HVI-certified to CAN/CSA-C439, "Rating the Performance of Heat Recovery Ventilators".

SUPPLEMENTAL KITCHEN EXHAUST (MAY BE REQUIRED) ■ May be a range hood. Supplemental kitchen exhaust fans which meet part of the total ventilation capacity requirements must have a sound rating of not more than 3.5 sones.

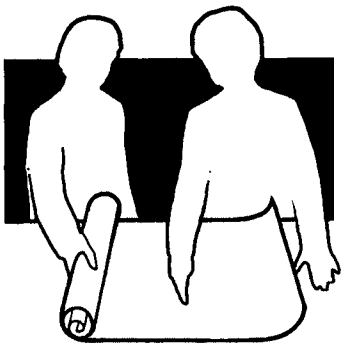
SUPPLEMENTAL BATHROOM EXHAUST (MAY BE REQUIRED) ■ Fan sound rating of not more than 2.0 sones if it is required to meet part of the total ventilation capacity requirements.

MAKE-UP AIR FANS ■ If handling untempered outdoor air, fans must be approved for such use. System may require an outdoor air pre-heater. May have to be custom designed and built. (At the time of publication, packaged make-up air systems for residential applications were not readily available.)

CARBON MONOXIDE DETECTORS/ALARMS ■ Required in each room with solid-fuel burning appliance that does not have doors which substantially close off the fire box. Must conform to CAN/CGA 6.19-M "Residential Carbon Monoxide Detectors".

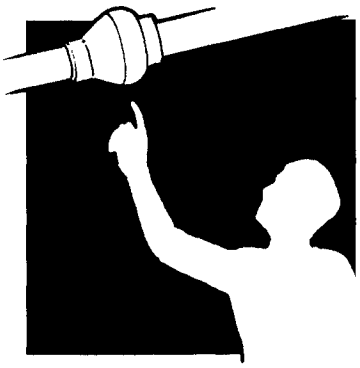
CONTROLS ■ Centrally-located manual switch labelled "Ventilation Fan" can operate Heat Recovery Ventilator at the principal exhaust flow rate. Supplemental exhaust fans are operated by a manual switch in each room served by the fan. The HRV and supplemental exhaust fans may also be activated by automatic controls. Make-up air systems operate automatically when the device they serve is operated.

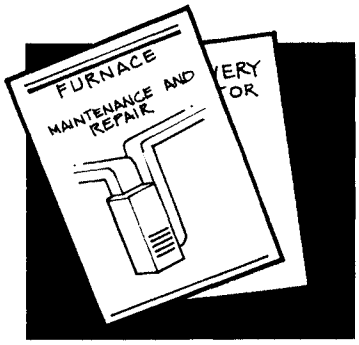
GETTING IT RIGHT THE FIRST TIME



In any construction project, good planning and clear communication will mean fewer problems. This is especially true for residential ventilation systems because the requirements are new and not widely known or understood. To minimize communication problems:

- Use installers who have taken ventilation installer training such as that offered by the Heating, Refrigerating and Air Conditioning Institute of Canada (HRAI).
- Prepare detailed ventilation system design drawings and specs, including schematics.
- Give copies to all the affected trades for their review to ensure:
  - any holes required in concrete foundations can be cast in place;
  - the gas meter, oil fill pipes, combustion appliance vents, dryer exhaust, garages, walkways, decks, steps, etc. will not interfere with the planned location of air intake or exhaust hoods, windows, etc.;
  - ductwork can be routed through stud and joist spaces;
  - control locations and types are clearly specified;
  - plumbing and electrical services are provided where needed.
- Make sure responsibility for each aspect of the ventilation system installation has been assigned and each trade is aware of its responsibilities.
- Advise all affected trades immediately of any changes to the system design.
- Closely inspect work before it is closed in. Verify that work has been done correctly, and control wiring and ductwork are in place.
- Inspect and test completed systems to verify operation and ensure components meet NBC requirements.
- Follow up on problems. Inform trades to prevent the same problems on future jobs.





BUILDER RESPONSIBILITIES

Builders are responsible for the performance of the ventilation system, and for ensuring that all codes and standards have been met. For this reason, they need a good general understanding of residential ventilation systems and equipment even though they rely on knowledgeable designers and tradespeople to provide detailed design knowledge.

Training in residential ventilation system design and installation is available through some colleges, agencies and manufacturers. The Heating, Refrigerating and Air Conditioning Institute of Canada (HRAI) (telephone 800–267–2231) offers national trades training and certification programs for residential heating, cooling and ventilation system designers and installers.

HRAI

Equally important is the builder's obligation to tell the homeowner how to operate and maintain the ventilation system. The builder should provide ventilation equipment literature, schematics and information on its operation, and the name of the ventilation system installer.

ENERGY CODES AND RESIDENTIAL VENTILATION

Energy codes legislate minimum energy performance standards for buildings. Energy codes have been implemented in some regions of Canada and are being developed for others. Where enforced, energy codes will include requirements for residential ventilation systems, over and above those outlined in building codes. Energy codes may require automatic dampers in Option 1 systems and HRVs in cold regions, or in houses with electric space heating.

Houses built in accordance with the R2000 Energy Efficient Housing Program also have special requirements for ventilation systems. The ventilation system designer must be aware of all special requirements for ventilation systems. The builder must ensure that the systems installed meet the NBC, energy code and any other jurisdictional requirements.

INTRODUCTION

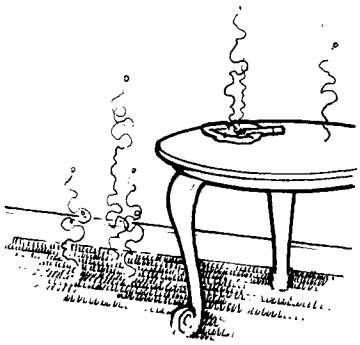
The introduction outlines the purpose of this manual, the need for ventilation, and the cost of operating or not operating a residential mechanical ventilation system.

PURPOSE OF THE MANUAL

The purpose of this manual is two-fold: 1) to help knowledgeable builders and residential HVAC installers understand the requirements of Section 9.32 Ventilation in the NBC; and 2) to present six ventilation system options that comply with these requirements.

A builder is not limited to the ventilation systems described in this manual. These systems were selected to cover the majority of applications, but may not suit some house designs or meet occupant needs.

THE NEED FOR VENTILATION



All homes require fresh air to deal with moisture, carbon dioxide generated by the occupants, common household smells and indoor pollutants. In the past, occupants depended on leaky construction and open windows to control odours and humidity. This resulted in cold, drafty dwellings during winter weather and very poor control over when or how much ventilation was provided. Even in very leaky houses, mechanical ventilation is required if reasonable air quality is to be maintained during warm, calm weather.

Because of the demand for more comfort and energy efficiency, new houses are built to leak less. The use of synthetic materials and finishes, household cleaners and personal hygiene products which give off complex chemical compounds has been increasing. Indoor air pollutants affect occupant health, so the NBC requires that mechanical ventilation systems be installed in all new housing to deal with these pollutants.

ELEMENTS OF AN EFFECTIVE INDOOR AIR QUALITY PROGRAM

Ventilation is one element in an effective indoor air quality (IAQ) program. Other elements include:

- source removal (e.g., storage of chemicals outside the living space);
- substitution (e.g., selection of natural fabrics and low emitting construction materials);
- source containment (e.g., storage of household chemicals in an airtight cabinet connected directly to an exhaust system);
- source control (e.g., sub-slab depressurization to control radon entry); and
- local exhaust (e.g., range hood).

All of these factors need to be addressed for effective indoor air quality management. Extraordinary measures may be required in dwellings with chemically sensitive occupants.

IAQ Strategy Checklist

- ❑ source removal
- ❑ substitution
- ❑ source containment
- ❑ source control
- ❑ local exhaust
- ❑ general ventilation

COST OF VENTILATING

Conditioning (i.e., heating, cooling, humidifying and filtering) outdoor air costs money, regardless of whether the air enters by fan or air leakage. An airtight dwelling with adequate mechanical ventilation will cost less to heat than a dwelling which is drafty enough to ensure indoor air quality is usually maintained. Furthermore, a properly ventilated airtight dwelling will experience less damage from condensation on and in windows, walls and attics, and the occupants will benefit from a healthier and more comfortable indoor environment.

Energy recovery increases initial costs but reduces operating costs by using energy in the exhaust air to heat the incoming outdoor air. A number of manufacturers produce packaged residential ventilators with integral heat exchangers. These are generically known as Heat Recovery Ventilators (HRVs) or Energy Recovery Ventilators (ERVs).

Energy recovery ventilation is an energy conscious choice. Because energy recovery substantially reduces the cost of operating the ventilating system, and may condition and distribute outdoor air without discomfort, the occupants are much more likely to use the ventilation system as intended.

CODE REQUIREMENTS

This section of the manual presents an overview of the residential ventilation requirements of the 1995 NBC.

WHAT DOES THE CODE COVER?

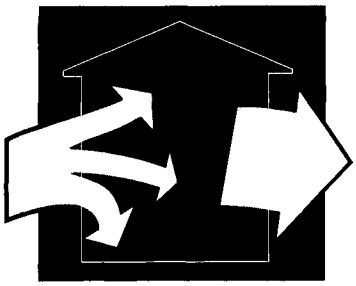
Part 9 of the NBC, Housing and Small Buildings Section 32 Ventilation, states that:

- all dwelling units with electrical power are required to have mechanical ventilation;
- self-contained ventilation systems serving only one dwelling unit can be designed in accordance with either Section 9.32 of the prescriptive requirements of the NBC or CAN/CSA-F326 "Residential Mechanical Ventilation Systems".

Section 9.32 addresses ventilation requirements, exhaust requirements, protection against house depressurization, duct sizing, outdoor air distribution, fan ratings, Heat Recovery Ventilators, outdoor intake and exhaust hoods, and system installation.

LIMITATIONS

Section 9.32 does not apply to multi-unit residential dwellings in which two or more suites share a ventilation system. It is not intended to meet the ventilation needs of spaces or activities with high airborne contaminant sources. Meeting the requirements of Section 9.32 does not guarantee acceptable air quality, especially for individuals who smoke, or who suffer from acute chemical sensitivities.

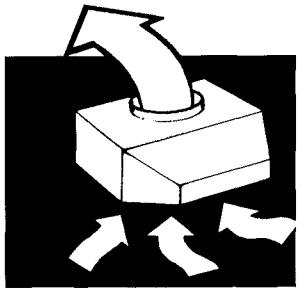


General Ventilation

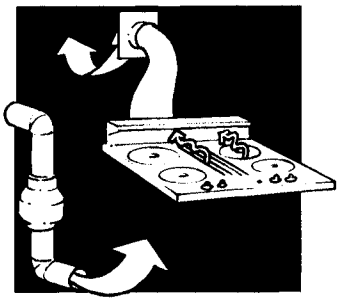
FUNDAMENTAL ELEMENTS OF A PART 9 MECHANICAL VENTILATION SYSTEM

Mechanical ventilation systems designed in accordance with Part 9 of the NBC must:

- have a total ventilation system capacity (i.e., the ability to ventilate at a rate) determined by the number and type of rooms and spaces in the dwelling unit;
- have a principal exhaust system capable of continuous operation at an air flow rate of at least 50 per cent of the total ventilation capacity;
- include a means to distribute outdoor air to certain areas of the house;
- exhaust directly from all kitchens, bathrooms and water closets;
- base fan selection on ability to provide the required air flows;
- use exhaust and ventilation system fans which meet specific sone (noise) ratings;
- provide make-up air systems for devices exhausting more than 75 L/s (160 cfm) if soil gas is deemed to be a problem or if there is a non-solid-fuel burning appliance vented through a chimney;
- provide carbon monoxide (CO) detectors/alarms in rooms with solid-fuel burning appliances if these do not have doors that substantially close off the firebox, or if make-up air is not provided for large exhaust devices.



Supplemental Exhaust



Make-up Air for Large Exhaust

NATURAL VENTILATION

Natural ventilation is provided by opening windows or other vent areas to a space. Dwellings not supplied with electricity must be provided with natural ventilation.

Houses with mechanical ventilation can use natural ventilation to control summer overheating. If a habitable room or space in a house is not provided with natural ventilation, it must have a mechanical ventilation rate of one half air change per hour if the space is air conditioned, and one air change if it is not.

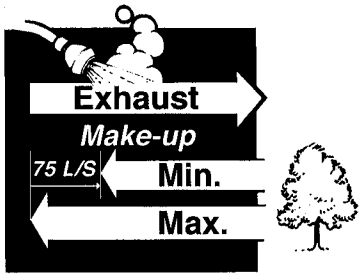
The NBC specifies the unobstructed openable ventilation areas that must be provided for code conformance.

HOUSE DEPRESSURIZATION

The NBC permits mechanical system designs which may at times depressurize the house. Depressurization occurs when the amount of air being mechanically exhausted from a house (or a space in a house) exceeds the amount of air which is being mechanically supplied to the house (or area). Clothes dryers, central vacs, exhaust fans, stove-top barbecue exhausts, the defrost cycle of some HRVs, and furnace circulation fans may cause local or whole-house depressurization.

WARNING – It is possible for the levels of unbalanced exhaust permitted in the NBC to cause significant levels of combustion appliance spillage, particularly in small or airtight houses. It is possible that depressurization will exceed the levels permitted in the codes regulating the installation of vented combustion appliances (e.g., CAN/CGA B149). The most effective ways to avoid this risk are to:

- install combustion appliances which are resistant to pressure-induced spillage;
- avoid using unbalanced exhaust appliances;
- install make-up air systems so exhaust air flows are balanced at all times by an equal supply of make-up air flow.



Depressurization becomes a concern when it impedes the complete venting of combustion products from combustion appliances (backdrafting or spillage), or increases the flow of soil gas into the living areas. Incomplete venting of combustion products and soil gas may cause health problems. The types of combustion appliances which are susceptible to pressure-induced spillage can generally be identified by the fact that they are vented through a natural draft chimney rather than through an arrangement which uses a fan to collect and expel the products of combustion from the house. Naturally-aspirated gas furnaces with draft hoods, and oil furnaces with barometric dampers, are examples of spillage-susceptible appliances. The terms commonly used for spillage-resistant combustion appliances include "direct vented" and "side-wall vented". Almost all fireplaces, including those with "airtight" doors, are spillage-susceptible. Most domestic gas cooking appliances and some " decorative combustion appliances" do not have to be vented.

The NBC has requirements to limit the risks to occupants of combustion spillage and soil gas. Outdoor air must be mechanically supplied to the house to offset air exhausted by the principle exhaust fan. Make-up air must be provided to minimize depressurization caused by devices which exhaust more than 75 L/s (160 cfm) if soil gas is deemed to be a concern, or if the house contains non-solid-fuel burning appliances vented through a chimney. CO detectors/alarms must be installed in rooms with solid-fuel burning appliances which are not equipped with doors that substantially close off the firebox. If solid-fuel burning appliances with doors that substantially close off the firebox and devices which exhaust more than 75 L/s (160 cfm) are installed in the house, either make-up air must be provided or CO detectors/alarms must be installed in all rooms with solid-fuel burning appliances.

Combustion of solid fuel produces high levels of CO. Properly running, non-solid-fuel burning appliances produce very low levels of CO. Thus CO detectors/alarms are useful in detecting low levels of flue gas spillage from solid-fuel burning appliances but not from non-solid-fuel burning appliances. Both types of combustion produce many other pollutants which are harmful to health.

The level of depressurization depends on the net exhaust from the house (i.e., the amount by which exhaust air exceeds supply air) and the air leakage characteristics of the house or space.

THE CODE

The text in section 9.32 Ventilation of the NBC is what Code enforcement agencies will use to evaluate a ventilation system design or installation. If any information in this manual is in conflict with the NBC, the NBC requirements prevail.

The NBC includes notes for Section 9.32 in an appendix. The appendix is a non-binding part of the Code; it provides general background and elaboration on actual Code requirements to elaborate on the intent of the committee responsible for this section of the Code.

SYSTEM COMPONENTS

This section provides information on some specific components of ventilation systems.

Information is included on:

- **FANS**
- **EXTERIOR HOODS**
- **GRILLES AND DIFFUSERS**
- **DAMPERS**
- **MAKE-UP AIR FANS**
- **OUTDOOR AIR TEMPERING DEVICES**
- **VENTILATION SYSTEM CONTROLS**
- **HEAT RECOVERY VENTILATORS (HRVS)**
- **DUCTWORK**

FANS

Ventilation systems designed to meet Section 9.32 Ventilation of the NBC require exhaust fans to supply outdoor air and possibly make-up air. When selecting a fan, several criteria must be considered. These are discussed in detail below.

FAN CERTIFICATION

Fans must conform to Canadian Standards Association (CSA) C22.2 No. 113-M, "Fans and Ventilators". This standard includes requirements for electrical safety, fire and personal injury. CSA C22.2 No. 113-M does not include testing for airflow performance or noise. Fans that have been certified to CSA 22.2 No. 113-M are identified with the Association's certification mark.

Grease accumulation and condensation on the cold surfaces and electrical components of fans can create an electrical safety hazard. For this reason, fans handling kitchen area exhaust or untempered outdoor air must be designed and approved by the manufacturer for such use.

TESTED/CERTIFIED

HOME VENTILATING INSTITUTE® DIVISION OF AMCA

Under Section 9.32, fan capacity and sound level ratings must be determined in accordance with CAN\CSA-C260-M "Rating the Performance of Residential Ventilating Equipment". The Home Ventilating Institute (HVI) publishes airflow performance and noise data to CAN/CSA-C260-M for residential ventilation fans in the "Certified Home Ventilating Products Directory". Products tested and certified by HVI must display the HVI label. This should be considered as the primary means of identifying HVI-tested/certified products. This directory is available free of charge from:

HVI
30 West University Drive
Arlington Heights, Illinois
60004–1893

(or)

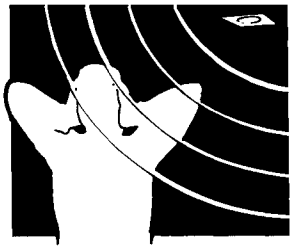
HRAI Canada
5045 Orbitor Drive
Building 11, Suite 300
Mississauga Ontario,
L4W 4Y4

FAN AIR HANDLING PERFORMANCE

In CAN/CSA-C260-M, fan capacity performance is expressed in terms of pressure drop (i.e., amount of ductwork and fittings against which the air must be moved), and air flow. Fans must be able to move at least as much air as required for the application they are installed to meet, but should not significantly exceed that requirement.

If the duct sizing charts and tables in Section 9.32 are being used, fan capacity must be based on fan (static) pressures of 50 Pa (0.2 in.W.G.) for in-line fans; 25 Pa (0.1 in.W.G.) for ducted fans (i.e., ductwork connected to only one side of the fan); or 7.5 Pa (0.03 in.W.G.) for direct discharge fans (i.e., no attached ductwork).

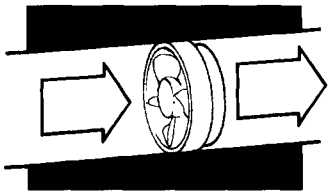
FAN SOUND RATINGS



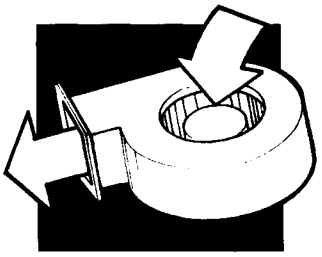
The NBC specifies maximum sound level (noise) ratings for fans which meet the total ventilation capacity requirements, except HRVs. Sound level ratings are not specified for HRVs or for fans which are not intended to meet any part of the total ventilation capacity requirements.

Maximum sound levels are 2.0 sones for the principal exhaust, auxiliary supply fans and supplemental bathroom exhausts, and 3.5 sones for supplemental kitchen exhaust fans. Sound level data is published in the HVI "Certified Home Ventilating Products Directory". Manufacturers provide instructions on how to install fans to achieve minimum sound ratings. Not following their instructions will usually increase operating noise levels.

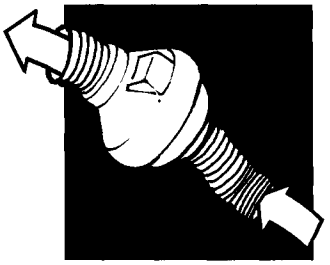
FAN CONFIGURATION



PROPELLER FANS are inexpensive fans suitable for low pressure applications. Common applications are low-cost bathroom fans, low-cost range hoods and through-the-wall fans. As a rule, ductwork should only be connected to the fan outlet side since air flow decreases rapidly as the amount of ductwork or number of fittings increases.

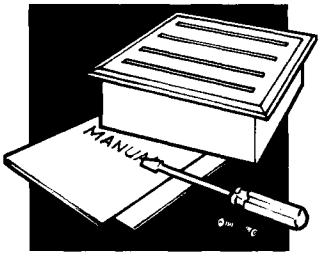


SQUIRREL CAGE FANS are less sensitive to the amount of ductwork and number of fittings than propeller fans. They are suitable where ductwork is connected both upstream and downstream of the fan. Squirrel cage fans are commonly installed in HRVs, better quality range hoods and central exhaust systems.



IN-LINE CENTRIFUGAL FANS (centrifugal fans that fit in-line with the ductwork) are popular as central exhaust fans because of their convenient installation, good performance and quiet operation.

FAN DURABILITY (SERVICE LIFE)



Principal exhaust fans and auxiliary supply fans should be capable of continuous operation over long periods of time. The quality of the bearings, rotor balancing and the ruggedness of the construction all influence longevity. Unfortunately, there is no third-party testing to assist in judging the durability of a particular fan. Product guarantees, past experience and recommendations from tradespeople represent the best means of determining product reliability.

FAN COSTS

INSTALLED COST or the cost to a builder of better quality fans is often lower than for budget fans because better quality fans are often easier to install and are less likely to result in a callback.

OPERATING COST is the occupant's cost to run and maintain a fan. Better quality fans are likely to consume less electricity and require less maintenance. Oversized fans use more electricity and increase heating and cooling requirements. Size and efficiency are important selection criteria for fans which will operate several thousand hours per year.

EXTERIOR HOODS

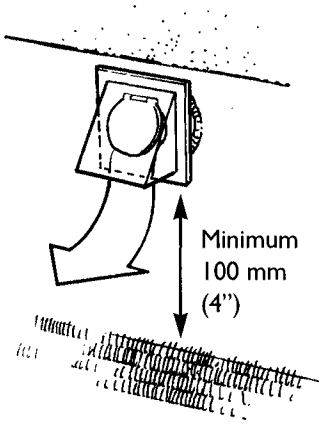
Exterior supply and exhaust hoods must penetrate the building envelope in a way which maintains the integrity of the rain screen on the exterior and the air/vapour barrier on the interior. They must keep out rain, snow, wind, birds and rodents.

Fuel codes specify minimum clearances between penetrations in the envelope and combustion appliance flue vents, gas meters, oil fill pipes, etc. The penetrations for which clearance restrictions apply include opening windows, and intake and exhaust hoods. Marking the location of all penetrations and outside services on the drawings will go a long way toward ensuring that clearance restrictions are not violated.

Hoods have a "performance cost" because they impose a pressure drop. Where a hood is supplied with a fan and was included in the fan certification testing, use it. Things to look for in a hood include:

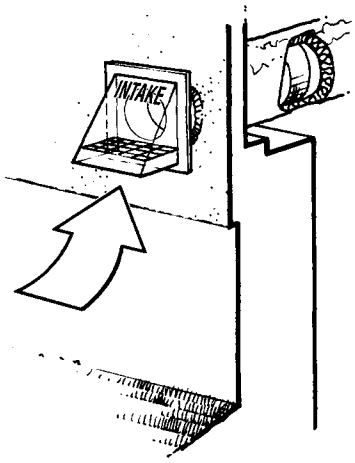
- hood "free-area" at least as large as the duct served;
- ease of sealing the hood to the building rain screen and air barrier to prevent water and air leakage into the building envelope;
- secure method to connect the duct to the hood;
- weather shield able to prevent entry of precipitation;
- construction that will not deteriorate from exposure to sunlight, and strong enough to withstand accidental bumps and bangs;
- bird and rodent screen (if required). If mesh size is smaller than 6 mm (1/4 inch), gross area of the screen must be at least three times that of the duct served, and must be removable for cleaning without requiring the use of special tools;
- double collar or "vapour barrier collar" construction to accommodate insulated duct connections.

EXHAUST HOOD REQUIREMENTS



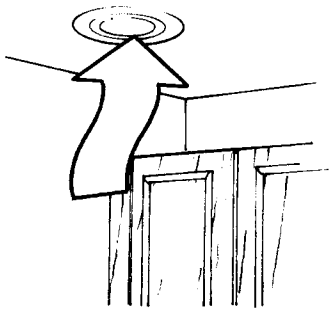
- Backdraft dampers are required in all exhaust ducts, except HRVs. Operation should be smooth and closure should be relatively airtight.
- Either a backdraft damper or a corrosion resistant rodent/bird screen must be located at the building envelope.
- Locate the bottom of the outlet at least 100 mm (4 inches) above finished grade or other nearer horizontal surface.
- Do not locate where condensation from the exhaust air can cause a hazard (e.g., ice on a sidewalk).
- Never terminate exhaust outlets in enclosed spaces (e.g., garages, attics, soffit spaces, crawlspaces, under decks). Moisture from the exhaust air will condense in and on building elements in cold weather.

INTAKE HOOD REQUIREMENTS



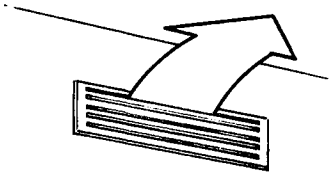
- Ducts carrying unconditioned outdoor air must be insulated and have an air/vapour barrier to avoid condensation on the cold duct surfaces.
- Label intake hood as an outdoor air intake. The label must be clearly visible.
- There must be a corrosion resistant rodent/bird screen or grille.
- Locate the bottom of the inlet at least 450 mm (18 inches) above finished grade or other nearer horizontal surface, and above the depth of expected snow accumulation.
- Locate hoods at least 900 mm (36 inches) away from gas vents, oil fill pipes, exhaust outlets and appliance vents.
- Air intakes will pick up debris and lint. Location must be accessible for cleaning (not under decks).
- Locate hoods away from sources of contamination, including gas meters, garages, driveways, garbage collection areas, exhausts from adjacent buildings, etc.

GRILLES AND DIFFUSERS



Grilles are the louvred or perforated covers over heating and ventilation system air inlets and outlets. Diffusers are grilles designed to diffuse or spread supply air throughout a space. Registers are grilles or diffusers with built-in flow control dampers. The size, type and location of grilles and diffusers can have an impact on the occupants' comfort and satisfaction with the ventilation system.

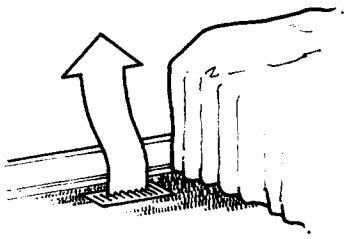
TYPE OF GRILLE



Common "heating" grilles are designed to direct air into room areas normally occupied by people, that is the "occupied zone". "Air-conditioning" grilles direct cool air along the ceiling or wall, allowing it to mix with space air before entering the occupied zone. If the air supplied will be cool at times, air-conditioning grilles are appropriate.

SIZE

Undersized grilles restrict air flows and may be noisy. The grille and terminal box should have a free area at least equal to the cross-sectional area of the connected duct. Where free area data is not available from a grille manufacturer, it may be estimated as 50 per cent of the face area of the grille (25 per cent if the grille includes a filter).



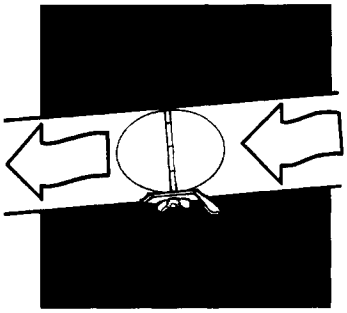
MOUNTING LOCATIONS

EXHAUST GRILLES in kitchens (except for range hoods) must be located in the ceiling or on the wall within 300 mm (12 inches) of the ceiling. If the grille is not equipped with a grease filter at the intake, the duct it serves must be designed and installed so that the entire duct can be cleaned. These requirements are intended to limit grease deposition and the related fire hazard in the ducts. In general, exhaust grilles should be located in areas where moisture and pollutants are generated.

SUPPLY AIR GRILLES should be selected and located to avoid drafts in the occupied zones. For ventilation systems not coupled to forced air heating systems, supply air outlets must be located in ceilings or walls within 300 mm (12 inches) of the ceiling and designed to promote mixing before the air enters the occupied zone.

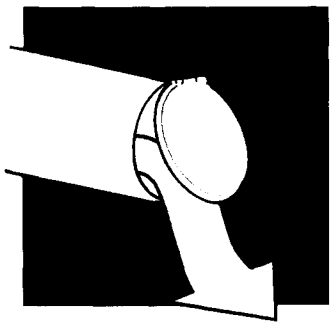
If a forced-air heating system mixes and distributes outdoor air through floor registers, use slot-type diffusers which direct air flow along walls. Where practical, consider using air-conditioning type diffusers in the ceiling or high on the wall.

DAMPERS



Dampers control air flow by obstructing the air flow passage to reduce or stop the flow in that duct. Air flow in one branch of a duct system can be increased by "dampering down" air flow in another branch. While the air flow in some ducts can be increased by sacrificing air flow to others, the net result will be a reduction in total air flow and perhaps an increase in noise levels. Dampers cannot compensate for undersized fans or for ducts which excessively restrict air flow.

BALANCING DAMPERS are required in all ventilation system branch ducts not fitted with registers. Balance dampers must be accessible and have a lock and a position indicator.

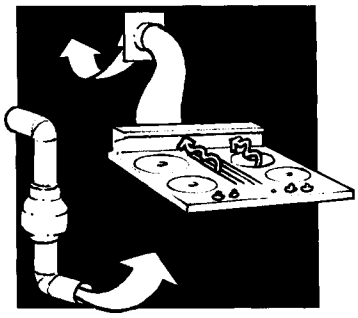


BACKDRAFT DAMPERS prevent air from flowing backwards in ducts. Exhaust systems, except HRVs, must have backdraft dampers to reduce air leakage when the fan is off. Poorly designed backdraft dampers may stick or freeze open or shut. Backdraft dampers need to function smoothly and seal tightly when closed. The fan must overcome the weight and balance of the damper. A heavy or stiff damper will restrict air flow.

MOTORIZED OR POWER DAMPERS provide automatic and positive duct opening and closure. The damper drive motor may operate at line voltage or low voltage, and must be interlocked with the fan served. Motorized dampers which handle untempered outdoor air must be approved by the manufacturer for that use.

MAKE-UP AIR FANS

THE REQUIREMENT FOR MAKE-UP AIR



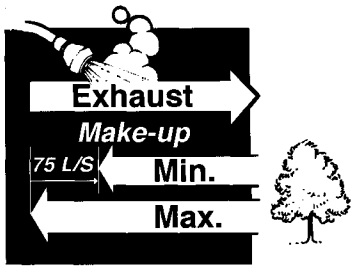
Devices which exhaust more air from a space than is mechanically supplied to the space will depressurize the space. Depressurizing houses may cause pressure-induced spillage of combustion products and soil gas entry into the house. The NBC includes measures to reduce these risks.

In either of two situations, the NBC requires that make-up air systems be provided for any exhaust device (or group of devices operated from a single control) which exhausts more than 75 L/s (160 cfm). The first is in houses which contain combustion appliances vented through a chimney. The other is where a soil gas mitigation system has not been installed even though soil gas is deemed to be a problem by local code authorities. Clothes dryers, central vacs, range hoods, downdraft cooktops, supplemental exhaust fans and HRVs with unbalanced defrost cycles are examples of appliances that may require make-up air. Where there may be a requirement for make-up air, it is wise to include provisions at the time of construction. Appropriate provisions include casting make-up air inlets in foundations and running wires for the system. When construction is complete, the need for make-up air may be re-assessed using an on-site test carried out according to CAN/CSA-F326. The results of such a test will more accurately indicate the required capacity of the make-up air system.

The NBC requires that make-up air be heated to at least 12 °C if it is introduced directly to a living area in the house. Alternatively, unconditioned make-up air can be supplied to normally unoccupied areas such as unfinished basements or utility rooms. Provision needs to be made to ensure that make-up air can freely flow to the exhaust device for which it is being provided.

It may be necessary to custom design and build make-up air systems. (At the time of publication, packaged make-up air systems for residential applications were not readily available.) This should only be undertaken by persons with expertise in the design of such systems.

SIZING MAKE-UP AIR FANS

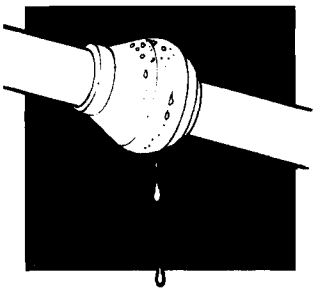


As a minimum, a make-up air fan must reduce the net exhaust of the device served to below 75 L/s (160 cfm). (Net exhaust is the difference between exhaust air flow and make-up air flow.) The maximum allowable make-up air flow rate is equal to the exhaust air flow rate of the device served (i.e., net exhaust reduced to zero). This allows a designer significant latitude in sizing make-up air fans and makes it possible for a single make-up air system to meet the needs of more than one large air exhausting device; however, this would significantly increase the risk of spillage of combustion products. Make-up air fans should not be oversized, because pressurizing a house can cause moisture problems in attics and exterior walls.

The NBC allows each air exhausting device or system to have a net exhaust of 75 L/s (160 cfm) before requiring make-up air.

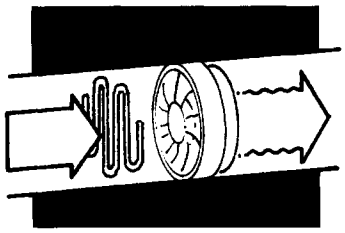
WARNING. Exhaust flow rates of less than 75 L/s (160 cfm) may cause flue gas spillage in some houses. The risk increases dramatically if more than one such device can operate at a time. The depressurization levels may also exceed those permitted under combustion appliance venting codes. For this reason, it is desirable to size make-up air systems as close as practical to the capacity of the exhaust device(s) they serve, thus reducing the net exhaust to zero.

SPECIAL REQUIREMENTS



Condensation on the cold surfaces and electrical components of fans can create an electrical safety hazard. For this reason, electrical devices which handle untempered outdoor air must be designed and approved by the manufacturer for such use. Make-up air ducts which carry untempered air through heated spaces must be insulated and have an air/vapour barrier on the outside surface to minimize surface condensation.

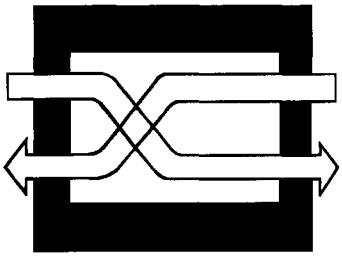
OUTDOOR AIR TEMPERING DEVICES



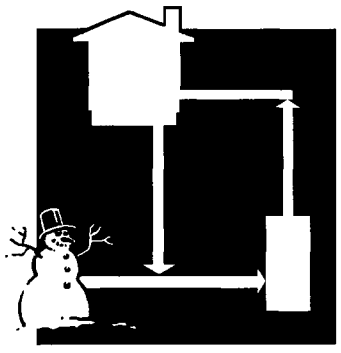
CODE REQUIREMENTS

Outdoor air may be brought into a house as ventilation air or as make-up air. The NBC requires that outdoor air be tempered before being passed through a furnace heat exchanger or delivered to living areas in the house.

Outdoor air being distributed by a forced air heating system must be introduced into the return air plenum downstream of all return air branch ducts. Acceptable means of tempering outdoor air being distributed by a forced air heating system include:



- preheating it to at least 12 °C;
- preheating it in an HRV;
- introducing it into the furnace return at least 3 meters (10 ft.) upstream of the plenum connection to the furnace;
- introducing it into the return air plenum through an approved mixing device.



If air passing over the heat exchanger in a fuel-fired furnace is colder than 15.5 °C, condensation may occur. This can lead to corrosion and premature failure of the heat exchanger. Furnace return air temperatures below 15.5 °C are likely to occur with the latter three of these preheat methods, especially in colder climates or if both ventilation air and make-up air are introduced through the furnace return air duct. In these cases, mixed air temperatures for daytime conditions can be calculated as described below, or may be determined using tables in the HRAI Residential Mechanical Ventilation manual. If return air temperatures are likely to fall below 15.5 °C, steps should be taken to increase the temperature or reduce the amount of outdoor air being supplied into the furnace return air duct.

Outdoor air being delivered to living areas of a house by means other than through a forced air heating system must be tempered using an HRV or a heating coil, and must be delivered through outlets located in the ceiling or on the wall within 300 mm (12 in.) of the ceiling. These outlets must be designed to promote mixing of supply air with room air.

Make-up air delivered to occupied areas through a supply duct system must be similarly tempered and delivered. Tempering is not required for make-up air introduced into normally unoccupied areas in the dwelling.

Note: As of 1995, powered make-up air systems (fan, tempering devices) are not readily available. Ensure that any components used in these systems are designed to operate with cold air.

Heating coils must be designed and controlled to provide supply air delivery temperatures of not less than 12 °C. The NBC includes a table for sizing pre-heaters. Specifying and installing heating coils (hydronic or electric) and related controls is a job for a qualified designer or contractor.

Frost protection is recommended for hydronic heating coils which heat outdoor air.

HRVs, which may be economical for pre-heating ventilation air, are generally not practical or economical for exhaust air make-up systems. Residential HRVs are not suitable for dirty applications such as range hoods and clothes dryers. HRVs are discussed in more detail in the section titled "Heat Recovery Ventilators".

CALCULATING MIXED AIRSTREAM TEMPERATURES

The mixed air temperature (MAT) for several airstreams can be calculated using the formula:

$$MAT = \frac{Q_h T_h + Q_v T_v + Q_{mu} T_{mu}}{Q_h + Q_v + Q_{mu}}$$

where:

- Q_h is the amount of house air in the mixed air stream, calculated as the amount of furnace return air flow with the furnace operating on low speed, minus the total amount of air from other sources in the return air stream.
- T_h is the temperature of house air.
- Q_v is the amount of ventilation air in the mixed air stream, with the ventilation system running on high speed.
- T_v is the temperature of the ventilation air stream at the winter design temperature.
- Q_{mu} is the amount of make-up air in the mixed air stream, with the make-up air system running on high speed.
- T_v is the temperature of the make-up air stream at the winter design temperature.

Other air streams can be added to this equation.

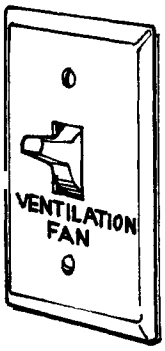
AVOIDING COMPLAINTS

Introducing cool air into an occupied space, even in compliance with NBC requirements, has the potential to cause discomfort. In general, a builder can avoid related complaints by:

- eliminating the need for make-up air systems by not using combustion appliances which vent through a chimney;
- eliminating the need for make-up air systems by not using high capacity exhaust devices;
- using more than one of the pre-heating or tempering measures and using good design and installation practices (e.g., mixing outdoor air with house air and then introducing it to a space through high-wall air-conditioning type diffusers, or mixing HRV supply air with house air in a forced air system).

VENTILATION SYSTEM CONTROLS

BASIC REQUIREMENTS



PRINCIPAL EXHAUST fans must be controlled by a centrally located manual switch labelled "Ventilation Fan". In addition to the manual control, principal exhaust fans may be controlled by a dehumidistat or other automatic control. The manual switch must be able to activate the principal exhaust fan regardless of the setting of the automatic control.

AUXILIARY SUPPLY fans must be controlled to operate anytime the principal exhaust fan runs.

FURNACE CIRCULATION fans in dwellings with ventilation systems coupled to the forced air heating system must be controlled to operate anytime the principal exhaust fan runs. This is to ensure that outdoor air is distributed throughout the house.

SUPPLEMENTAL EXHAUST fans must be controlled by manual switches located in the rooms served. In addition to this, they may be controlled by dehumidistats or other automatic controls. The manual switch must be able to activate the supplemental exhaust fan regardless of the setting of the automatic control.

HRVs usually provide both the principal exhaust fan and auxiliary supply fan functions. The control requirements noted above for these types of fans will apply to most HRV installations.

MODES OF OPERATION

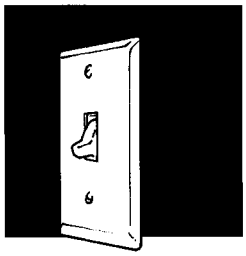
MANUAL OPERATION requires the occupant to turn the ventilation system on and off. The system runs only when the occupant turns it on.

AUTOMATIC OPERATION uses controls such as time clocks, dehumidistats and occupancy sensors to operate the ventilation system.

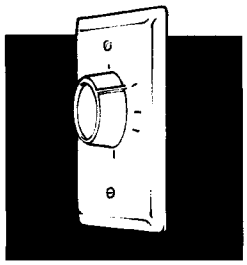
CONTINUOUS OPERATION ensures that the house is always ventilated, but may result in overventilation at times. All ventilation systems must include manual controls, even if the occupant installs automatic controls or plans to operate the ventilation system continuously.

HIGH/LOW OPERATION uses a two-speed fan which normally operates on low speed. When increased ventilation is called for, it switches to high speed. High speed operation may be initiated by manual and/or automatic controls.

TYPES OF CONTROLS

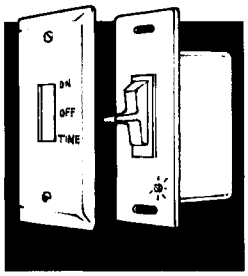


ON/OFF SWITCHES allow occupants to control when fans operate. They are inexpensive and their operation is well understood. However, they do not ensure that fans will be turned on and off as required.



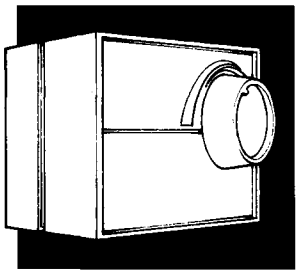
TIMER SWITCHES (mechanical or electronic) have operating times that range from a few minutes to several hours. A timer switch turns the power off at a predetermined time after the fan has been activated. Spring wound "crank timers" allow the user to select the operating time with each use. Electronic "touch timers" have a pre-set period of operation, which can be adjusted. Timer switches do not ensure that fans are operated when needed, but rather that they are turned off (or the speed reduced in the case of High/Low operation).

DELAYED OFF SWITCHES are combination manual/timer switches. The fan is activated manually. The user can then turn the fan off immediately, as with a manual switch, or activate a timer which runs the fan for a predetermined time period before turning it off. This has the advantage of letting ventilation continue after the occupant has left the room without allowing the fan to run indefinitely.



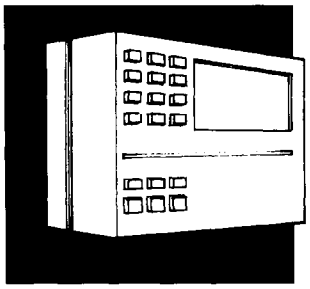
TIME CLOCKS which control the ventilation system based on time of day and day of week may be appropriate where occupancy follows a regular schedule. The timer can be scheduled to turn the ventilation system off after occupants normally leave and turn it on again shortly before they return. Twenty-four hour and seven-day timers with "holiday" over-rides are readily available.

DEHUMIDISTATS are the only commonly available "demand controllers". They operate the ventilation system (or activate high speed) when humidity levels exceed the control setpoint. This may help control indoor humidity, but does not ensure control of other pollutants.



It is common to adjust the dehumidistat to control window condensation; therefore, the appropriate humidity setpoint will vary with outdoor temperature. Occupants should be instructed to lower the dehumidistat setting in cold weather to reduce window condensation, and to turn the dehumidistat to the "off" position in summer.

In dwellings with humidifiers, occupants should be advised to set the humidistat at least 15 per cent lower than the dehumidistat.



AUTOMATIC DEMAND CONTROLS, which operate the ventilation system only when needed, have been the object of much research. The ideal ventilation system would monitor and control the level of all contaminants in the house air. To date, only sensors for humidity, carbon dioxide and carbon monoxide have been commercially developed and marketed for residential applications.

OCCUPANCY SENSORS (i.e., devices which sense when someone is in a space) have been developed and are allowed under the NBC. They are now available for residential ventilation system control.

MULTIPLE CONTROLS are permissible and often desirable. For example, a single supplemental exhaust fan may serve more than one bathroom provided that a manual switch is located in each bathroom. Automatic and manual control of a fan is also possible. Multiple controls can be parallel-wired so that any control can turn on the ventilation system, regardless of the setting on others. If regular on/off switches are used, all controls must be in the off position in order to turn a ventilation system component off. The use of three-way and four-way light switches can get around this problem.

LINE VOLTAGE/LOW VOLTAGE CONTROL

Line Voltage Controls must be wired by an electrician, in accordance with the electrical code. Line power wiring can be relatively expensive if multiple controls are being used.

Low Voltage Controls (12 and 24 VDC) use less expensive wire but require transformers and relays. Low voltage controls do not have to be wired by an electrician. Many packaged ventilators and HRVs have low voltage controls built in, allowing the installer to do the controls wiring. Electrical codes generally prohibit making low voltage and line voltage connections in the same electrical box.

ELECTRICAL INTERCONNECTIONS

The code requires that certain fans be controlled to operate in conjunction with other devices. These include make-up air systems, furnace circulation fans, and auxiliary supply fans. Methods of controlling fans include using:

- relays or double pole double throw switches,
- direct electrical connections to the exhaust device,
- current sensors on the power line to the exhaust device,
- air flow sensors in the exhaust device outlet.

Relays and double pole double throw switches can be used to control more than one electrical device simultaneously. Relays can operate several sets of contacts at once, and may operate at line voltage or at low voltage. Double pole double throw switches are light switch type devices which can switch devices in two separate electrical circuits simultaneously.

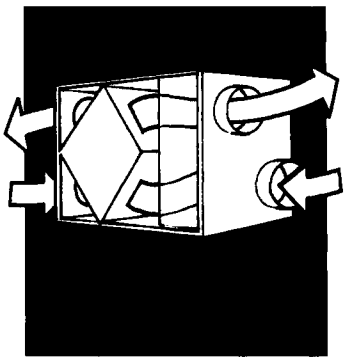
Some exhaust devices have an integral switched electrical outlet or terminals which are powered whenever the exhaust device is operated. This makes it possible to connect a make-up air fan to the exhaust device.

A knowledgeable electrician can make electrical connections inside most electrical devices. However, this may invalidate warranties. Furthermore, special inspections and approvals by an electrical inspector will be necessary.

A current sensor on the power line to an electric device is a recommended method to electrically interconnect it to devices that do not have switched electrical connections. The current sensor senses when electricity flows in a power line. It can control a relay which operates the second device when the first device is turned on.

An air flow sensing switch or pressure sensor located in the outlet of the first device can also be used to control the second device. These are less desirable solutions because flow sensing switches may restrict air flow or be immobilized by lint, dirt or grease in the exhaust stream.

HEAT RECOVERY VENTILATORS (HRVs)



HRVs can provide continuous, balanced ventilation; energy costs are lower; and comfort levels are higher when compared to ventilation systems without energy recovery. Many builders install HRVs in show homes to enhance their image with a public which is becoming increasingly aware of indoor air pollution and energy conservation.

HRVs coupled to forced air heating systems must supply outdoor air directly into the return duct of the forced air heating system; otherwise, the ventilation system must be designed to CAN/CSA-F326. An HRV's ductwork must not be connected in parallel air flow to another HRV unless specifically recommended by the manufacturer.

The supply and exhaust airflows for an HRV operating at the principle exhaust flow rate must be balanced to within 10 per cent of each other, unless otherwise recommended by the manufacturer. The HRV must be installed in a location where ambient temperatures will not affect its operation or freeze the condensate drain. The condensate drain must meet the manufacturer's recommendations or be a minimum 1/2 inch nominal pipe size, pitched in the direction of flow, and have a trap or condensation pump.

HRVs installed to provide all or part of the ventilation requirements of the NBC must be rated in accordance with CAN/CSA-C439 "Rating the Performance of Heat Recovery Ventilators". Ratings for certified equipment are available from manufacturers, suppliers and the Home Ventilating Institute (HVI) "Certified Home Ventilating Products Directory". This directory is available free of charge from:

HVI
30 West University Drive
Arlington Heights, Illinois
60004–1893

(or)

HRAI Canada
5045 Orbitor Drive
Building 11, Suite 300
Mississauga, Ontario,
L4W 4Y4

SELECTING AN HRV

The performance of various HRVs can be compared to the CAN/CSA-C439 test results. Equipment certified by HVI has undergone standard tests to determine air movement capacity, heat recovery efficiency and cold weather performance characteristics.

When selecting an HRV, consideration should be given to:

- installation convenience (e.g., top vs side ducts);
- whether the HRV will sufficiently depressurize the house during defrost to require make-up air;
- ability of the equipment to meet the ventilation requirements;
- heat recovery efficiency during cold weather operation;
- local availability of qualified installers, service people and parts;
- installed cost of the equipment.

DUCTWORK

SIZING

Ventilation system ducts must be sized according to Section 9.33 of the NBC except when special conditions are met. Section 9.32 provides tables which simplify the duct sizing process when these special conditions are met. The simplified duct sizing tables are applicable to systems with short duct runs. Tables are provided for:

- principal exhaust fan ductwork (includes HRV exhaust side),
- auxiliary supply fan ductwork (includes HRV supply side),
- supplemental exhaust ductwork,
- outdoor air supply trunk ducts and branch ducts,
- round to rectangular ductwork equivalents.

The tables in Section 9.32 can only be used if special conditions are met. The System Option Sheets in the last section of this manual identify the duct sizing table for each type of ductwork. If these conditions are not met, more detailed duct sizing methods must be applied, such as those outlined in ASHRAE or HRAI manuals.

Because the conditions under which each table can be used are different, care must be taken to use the correct table and conditions for each duct being sized.

DUCT MATERIALS

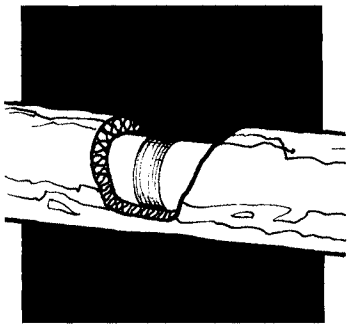
Ventilation system ductwork must conform to the Section 9.33 requirements for supply ducts. Ducts connected to a forced air heating system and range hoods must be made of noncombustible materials. Ductwork not connected to a heating device may be made of combustible materials. Ducts serving bathrooms or water closets must be constructed of a material impervious to water. Flexible ducts must meet the requirements for CAN/ULC-S110-M. Kitchen exhaust ducts not equipped with an accessible filter at the intake end must be designed and installed so that the entire duct interior can be cleaned. In most residential applications, the filter will be more practical. Ductwork for range hoods and range-top fans must have a filter at the intake end, be non-combustible and corrosion resistant, and lead directly to the outdoors without connection to other exhaust ducts or fans.

WORKMANSHIP

Ductwork must be permanently supported or clipped to prevent sagging, excessive movement and vibration. Use of vibration isolating connections between fans and ducts is recommended. Assemble ductwork joints and fittings so as to inhibit air leakage. Joints in round ductwork should be lapped at least 25 mm (one inch) and mechanically fastened.

Exhaust ducts passing through unheated spaces should be sloped to the outdoors to prevent condensation dripback. HRV cold-side exhaust ducts should be sloped to prevent water accumulation in low spots.

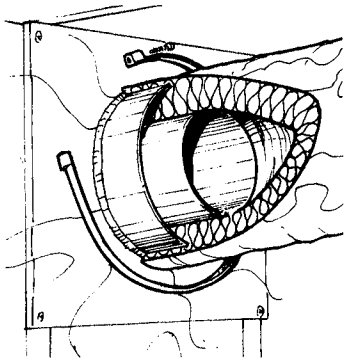
Good workmanship is demonstrated by straight duct runs with a minimum of bends and elbows and tight fitting, mechanically fastened joints. Likely air leakage spots should be sealed with good quality duct tape or paint-on duct sealer. Ductwork should be cleared of debris to ensure airflow and air quality standards can be met. It is desirable to permanently install flow measuring stations in the supply and return trunk ducts for HRVs. The HRAI Residential Mechanical Ventilation Guide should be followed as a guide to good practice.



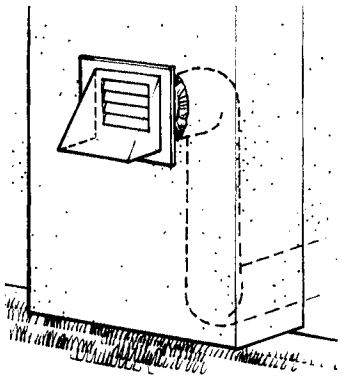
A builder should ensure that the house designer is sensitive to mechanical system requirements. A modest amount of planning and trades coordination will go a long way in facilitating good workmanship, tidy installations and effective ventilation systems.

INSULATION AND VAPOUR BARRIERS

Ducts carrying warm air through unheated spaces or unconditioned outdoor air through heated spaces must be insulated and provided with a suitable air/vapour barrier on the warm side to prevent condensation in or on the ducts. The air/vapour barrier on ducts which pass through the house air/vapour barrier must be sealed to the house air/vapour barrier at the point where the duct passes through it. This can be accomplished using a double collar duct connector on a piece of plywood. The plywood is sealed to the house air/vapour barrier. The duct and its air/vapour barrier are fastened to the double collar connector.



Exhaust ducts passing through unheated spaces (e.g., attics, crawlspaces, garages) and ducts up to 3 m (10 feet) long carrying outdoor air through heated spaces must be insulated to RSI 0.5 (R 2.8) or more. Insulation requirements for cold-side HRV ducts in heated spaces which are over 3 m (10 feet) long vary with outdoor winter design temperature. The colder the outdoor design temperature, the more insulation is required. Information from the NBC regarding insulation requirements is repeated in the System Option Sheets in the last section of
this manual.



TERMINATIONS

Exhaust and ventilation ducts must terminate directly to the outdoors. A duct riser may be required to ensure duct terminations meet the minimum clearances above grade. Ducts must not terminate in closed spaces such as crawlspaces, attics, soffits and garages. The air quality in these locations makes them an unacceptable source for outdoor air, and the problems caused by condensation from exhaust air during cold weather makes them unacceptable for exhaust outlets.

SYSTEM OPTIONS

Detailed descriptions are provided for six ventilation system options which meet the National Building Code requirements.

SYSTEM OPTIONS

Builders are responsible for ensuring that ventilation systems installed in new dwellings meet the NBC. Builders may choose to design ventilation systems or may select from the six system options described in this section of the manual. In any case, builders should consult with homeowners to ensure that the ventilation system selected will meet the owners' needs and expectations. They should also confirm that the systems will meet local code requirements.

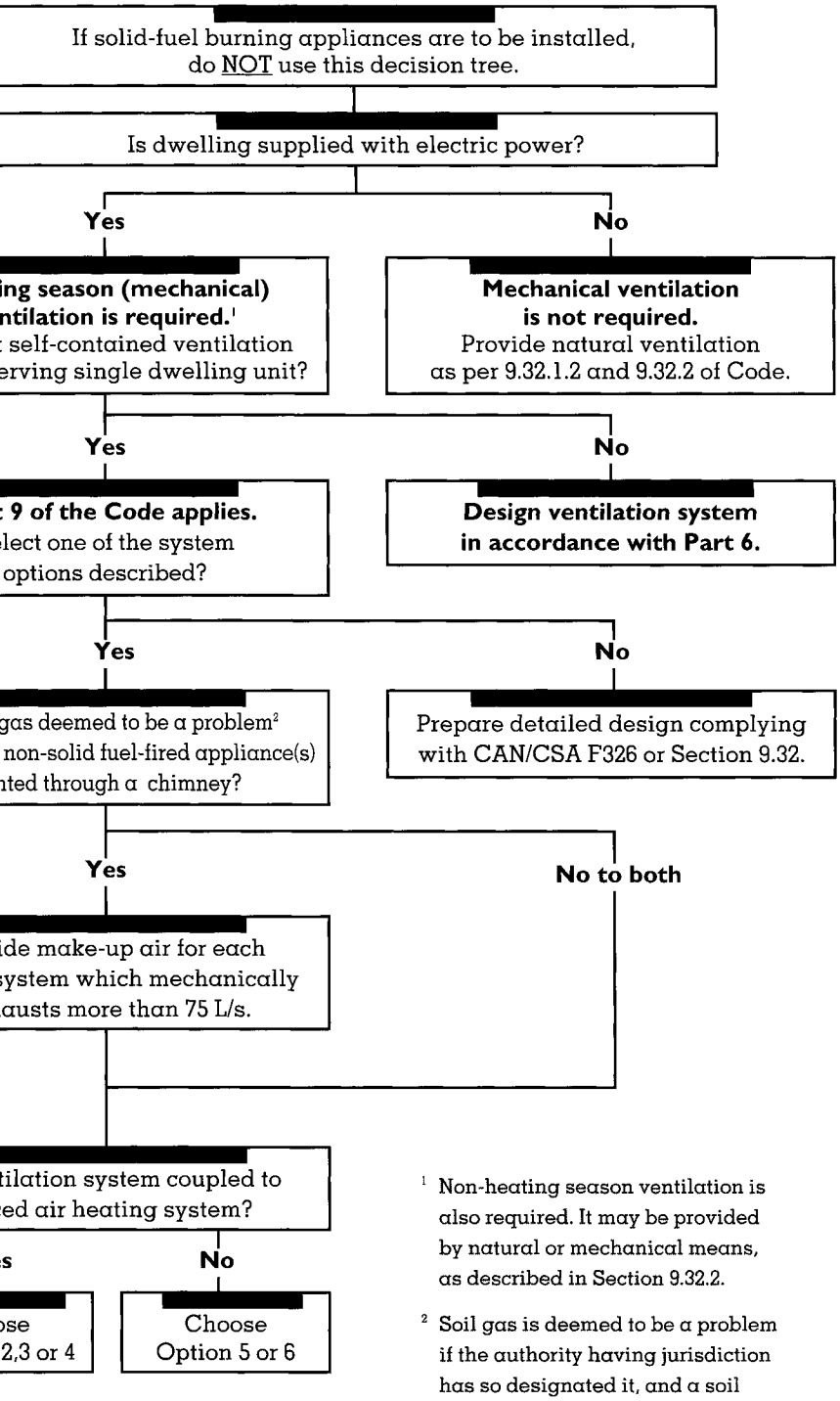
The six system options described in this manual will help builders meet the NBC requirements with a minimum of confusion. One or more of these ventilation system options will be suitable for most dwellings, although some dwellings may require custom designed ventilation systems.

The following pages contain specific information on each ventilation system option, including:

- two Ventilation System Decision Trees to help users determine which ventilation system design approach to use (i.e., Part 6, Part 9 or CAN/CSA-F326) and which Part 9 ventilation system options may be used;
- a four-page information pull-out for each of the Part 9 ventilation system options described. The pull-outs describe the basic functions and controls for each ventilation system, provide data needed to size and select ventilation system components, and give a checklist of items for consideration when planning and installing the ventilation system.

Users of this manual are encouraged to photocopy the pullouts or any other part of the manual that will help explain ventilation system design, installation or operation to builders, subcontractors and customers.

1995 NBC VENTILATION SYSTEM DECISION TREE
FOR HOUSES WITHOUT SOLID-FUEL BURNING APPLIANCES



[1] Non-heating season ventilation is also required. It may be provided by natural or mechanical means, as described in Section 9.32.2.

[2] Soil gas is deemed to be a problem if the authority having jurisdiction has so designated it, and a soil gas mitigation system has not been installed.

OPTIONS

OPTION 1
Outdoor air supply duct coupled to a forced air furnace return.

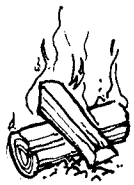
OPTION 2
Auxiliary supply fan coupled to a forced air furnace return.

OPTION 3
HRV coupled to a forced air furnace/ extended principal exhaust ductwork.

OPTION 4
HRV coupled to a forced air furnace/ simplified principal exhaust ductwork.

OPTION 5
Auxiliary supply fan not coupled to a forced air furnace.

OPTION 6
HRV not coupled to c forced air furnace.



OPTIONS

OPTION 1

Outdoor air supply duct coupled to a forced air furnace return.

OPTION 2

Auxiliary supply fan coupled to a forced air furnace return.

OPTION 3

HRV coupled to a forced air furnace, extended principal exhaust ductwork.

OPTION 4

HRV coupled to a forced air furnace, simplified principal exhaust ductwork.

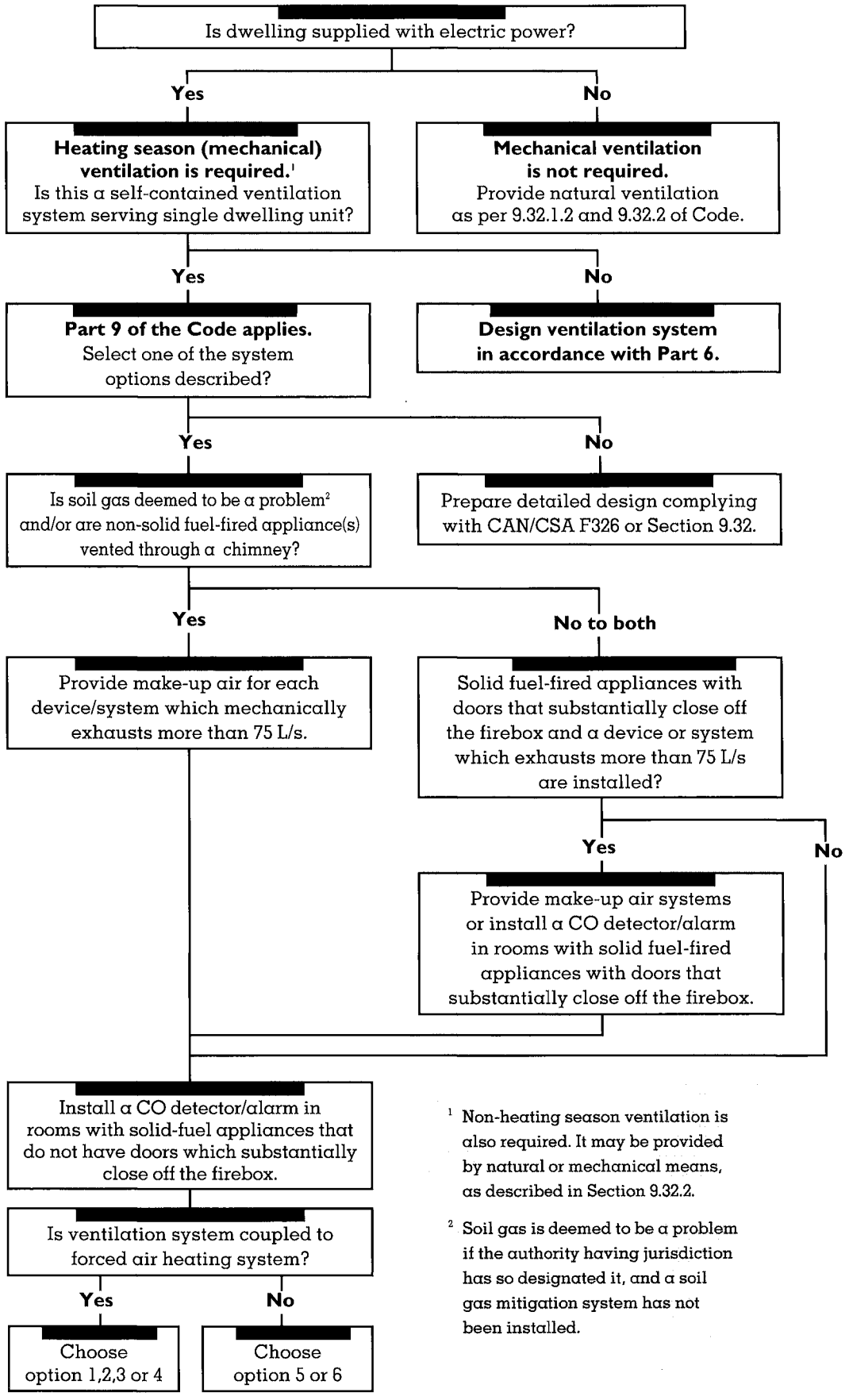
OPTION 5

Auxiliary supply fan not coupled to a forced air furnace.

OPTION 6

HRV not coupled to a forced air furnance.

1995 NBC VENTILATION SYSTEM DECISION TREE FOR HOUSES WITH SOLID-FUEL BURNING APPLIANCES



[1] Non-heating season ventilation is also required. It may be provided by natural or mechanical means, as described in Section 9.32.2.

[2] Soil gas is deemed to be a problem if the authority having jurisdiction has so designated it, and a soil gas mitigation system has not been installed.

VENTILATION SYSTEM SPECIFIER AND INSTALLER'S GUIDE TO OPTION 1

OUTDOOR AIR SUPPLY DUCT COUPLED TO A FORCED AIR HEATING SYSTEM

COMPONENT	CAPACITY
■ PRINCIPAL EXHAUST FAN(S)	
• Exhausts from kitchen and/or bathrooms or other central location to outdoors. • Capable of continuous operation. • Controlled by centrally-located manual switch. May also have automatic control(s).	Principal exhaust capacity at least 50 per cent of minimum Total Ventilation Capacity.* If it is more than 75 per cent of minimum Total Ventilation Capacity, provide controls to adjust flow to within 10 per cent of the lower limit.
■ OUTDOOR AIR SUPPLY SYSTEM	
• Outdoor air intake connected to furnace return plenum. • Suction in furnace return plenum draws in outdoor air; furnace fan distributes it. • Controls operate furnace fan when principal exhaust operates.	Outdoor air supply matches principal exhaust flow rate. Size duct using Section 9.33 unless the outdoor air supply duct is not more than 6 m (20 feet) and not more than two elbows, then use Table 9.32.3.6.A.
■ SUPPLEMENTAL EXHAUSTS	
• Supplemental exhaust required in each bathroom not served by principal exhaust. • Supplemental exhaust required in kitchen if principal exhaust serves any other area. • Controlled by manual switch in room served. May also have automatic control.	• 25 L/s (50 cfm) from each bathroom or water closet, if required. • 50 L/s (105 cfm) from kitchen, if required. • Sum of principal exhaust and all supplemental exhausts must equal or exceed minimum Total Ventilation Capacity.*
■ MAKE-UP AIR FANS	
• Make-up air fan required for any device which exhausts over 75 L/s (160 cfm)...IF soil gas is deemed to be a problem but a soil gas mitigation system is not installed...OR a fuel-burning appliance which is vented through a chimney is present.** • Controlled to operate with exhaust device.	• Minimum make-up air fan capacity equals exhaust flow of device minus 75 L/s (160 cfm). • Maximum make-up air fan capacity equals exhaust flow of the device. • Make-up air must be tempered if introduced into normally occupied spaces. • Fans handling untempered outdoor air must be designated for such use by the fan manufacturer.
■ COMBUSTION AIR SYSTEMS	
• Combustion air may be required for vented combustion appliances. Ventilation and makeup air systems are not considered to provide combustion air.	• Size as per respective code (i.e. gas, oil, solid fuel, etc.).

* Minimum Total Ventilation Capacity is the sum of:
30 L/s (65 cfm) total for the master bedroom, kitchen, dining, living and the first bathroom,
5 L/s (10 cfm) for each additional habitable room, excluding the furnace room, storage areas, entrances and corridors,
10 L/s (20 cfm) for an unfinished basement, 5 L/s (10 cfm) if the unfinished area is less than 2/3 total basement floor area.

** If all fuel burning appliances which are vented through a chimney are solid-fuel burning, this requirement can be ignored if CO detectors/alarms are installed in each room with a solid-fuel burning appliance installed.

OPTION 1 ▪ OUTDOOR AIR SUPPLY DUCT COUPLED TO A FORCED AIR HEATING SYSTEM

1 Combustion air supply required for each vented combustion appliance, including fireplaces and woodstoves. Ventilation and make-up air are not combustion air.

2 Install a carbon monoxide detector/alarm in each room containing a solid-fuel burning appliance with doors that do not substantially close off the firebox. If doors substantially close off the firebox and make-up air system(s) are installed, a CO detector/alarm is not required in that room.

3 Provide make-up air for each device which exhausts more than 75 L/s (160 cfm) if soil gas is deemed to be a problem, or if non-solid-fuel burning appliances are vented through a chimney. Make-up air system must reduce net exhaust of device to less than 75 L/s (160 cfm).

4 Make-up air fan controlled to operate when the device served operates. Make-up air heated to at least 12°C unless delivered to a normally unoccupied area in dwelling.

As of 1995, powered make-up air systems (fan, tempering devices) were not readily available. Ensure that any components used in these systems are designed for operation with cold air.

5 Opening windows provide natural ventilation to each habitable space, otherwise provide 1.0 ACH mechanical ventilation (0.5 ACH if space is air-conditioned), designed in accordance with Section 9.33.

6 Kitchen exhaust intake (except range hood) located in ceiling or wall within 300 mm (12 inches) of ceiling. Duct accessible for cleaning unless intake is equipped with a readily serviceable grease filter.

7 50 L/s (105 cfm) supplemental exhaust from kitchen if principal exhaust serves any room other than kitchen. Fan controlled by manual switch in kitchen. Maximum 3.5 sone rating for supplemental kitchen exhaust fans which help meet the total ventilation capacity.

8 25 L/s (50 cfm) supplemental exhaust from each bathroom not served by principal exhaust. Fan controlled by manual switch in bathroom served. Maximum 2.0 sone rating for supplemental bathroom exhaust fans which help meet the total ventilation capacity.

9 Size supplemental exhaust ducts up to 9 m (30 feet) long and not exceeding four elbows, using Table 9.32.3.5; otherwise, use Section 9.33.

10 Ventilation equipment in unheated spaces installed to avoid condensation on fans and motors as per manufacturer's instructions. Insulate exhaust ducts in unheated spaces to RSI 0.5 (R 2.8).

11 Locate outdoor air intakes well away from contamination sources (e.g., automobile exhaust, building exhaust) and at least 900 mm (36 inches) from combustion appliance vents, oil fill pipes, gas meters, etc. Intake hoods are labelled for easy identification and accessible for service.

12 Exhaust ducts do not discharge into heated or unheated enclosed spaces.

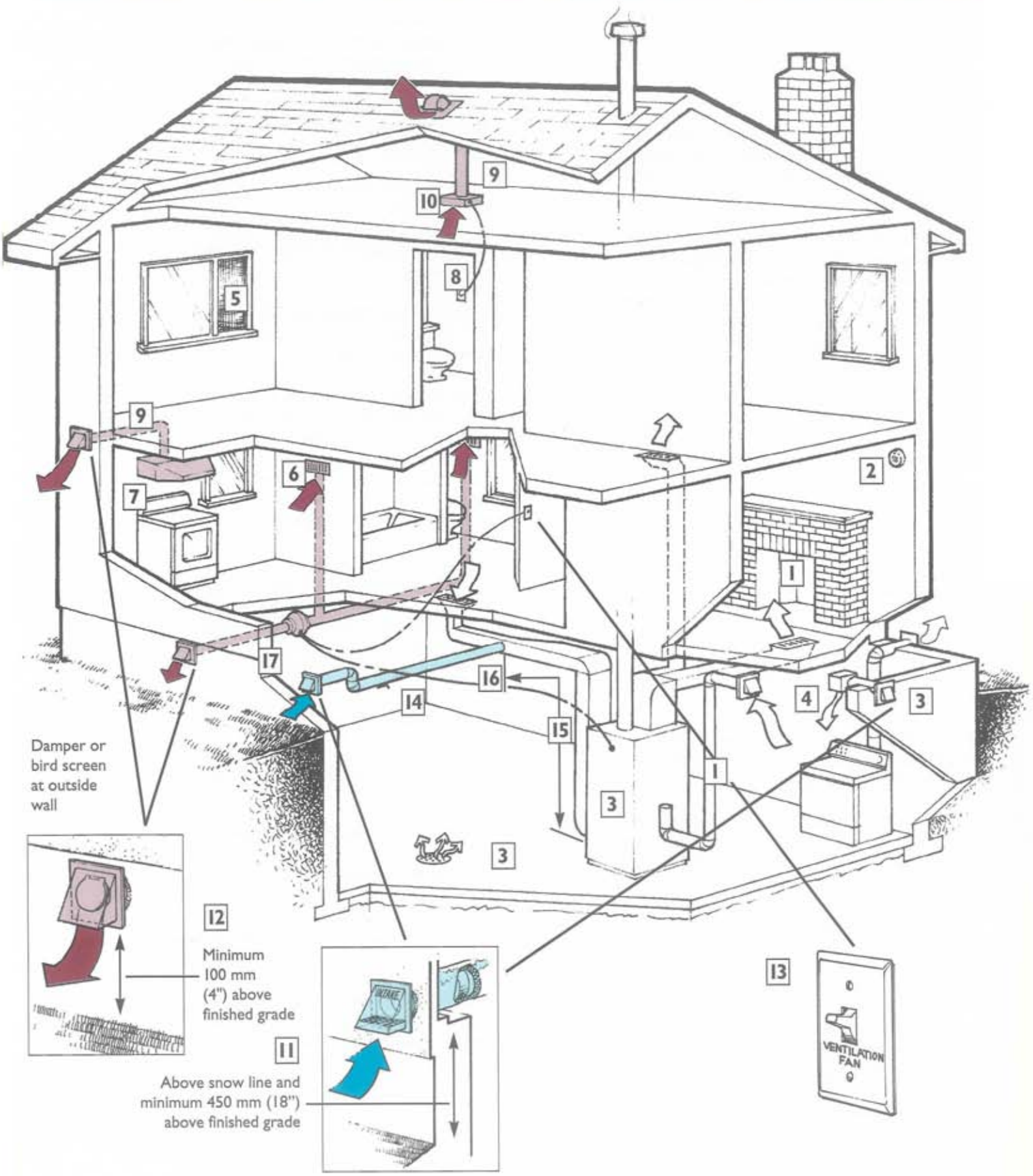
13 Centrally-located manual switch labelled "Ventilation Fan" activates principal exhaust fan and furnace circulation fan.

14 Accessible balance damper with position indicator and lock. Stop prevents damper from being closed beyond 45°.

15 Outdoor air supply duct directly connected to return plenum downstream of all return branch ducts, and at least 3 m (10 feet) upstream of furnace unless connected through an acceptable mixing device.

16 Size outdoor air supply ducts up to 6 m (20 feet) long and not exceeding two elbows, using Table 9.32.3.6.A; otherwise, use Section 9.33. Insulate ducts carrying untempered outdoor air through heated spaces to at least RSI 0.5 (R 2.8).

17 Size principal exhaust ducts up to 12 m (40 feet) long and not exceeding four elbows, using Table 9.32.3.4; otherwise, use Section 9.33.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3
Damper or bird screen at outside wall
12
Minimum 100 mm (4") above finished grade
11
Above snow line and minimum 450 mm (18") above finished grade
13
VENTILATION FAN

Inspection Checklist

OPTION 1

NBC REQUIREMENTS

- ☐ Combustion air provided for vented combustion appliances as required by fuel codes.
- ☐ CO sensor with audible alarm meeting CAN/CGA-6.19-M installed in each room with a solid-fuel burning appliance not equipped with airtight doors.
- ☐ Make-up air provided for devices which exhaust more than 75 L/s if soil gas is a problem, or if non-solid-fuel burning appliances are vented through a chimney. Make-up air tempered to at least 12 °C or delivered to a normally unoccupied area.
- ☐ Ductwork sized using Section 9.32 tables or detailed design according to Section 9.33. In any case, ductwork not smaller than recommended in manufacturer's literature.
- ☐ Fans are HVI-certified and meet NBC requirements for airflow capacity and sound ratings.
- ☐ Kitchen and all bathrooms have exhaust. Supplemental exhaust fans have manual control in room served.
- ☐ Kitchen exhaust duct is non-combustible. Duct has grease filter installed at intake or is accessible for cleaning.
- ☐ Exhaust ducts discharge directly to outdoors. Outlets at least 100 mm (4 inches) above finished grade.
- ☐ Outdoor air intake hoods have corrosion-resistant screen to keep out small animals. If mesh is less than 6 mm (1/4 inch), gross area is three times the duct area and is accessible and removable for cleaning without special tools.
- ☐ Outdoor air intake and exhaust openings are protected from weather.
- ☐ Outdoor air intakes are above snow line and at least 450 mm (18 inches) above finished grade and accessible for cleaning.
- ☐ All ducts which carry cold air through conditioned spaces or warm air through unconditioned spaces are insulated and have vapour barrier on warm side.
- ☐ Fans, motors and heaters handling untempered outdoor air designated by the manufacturer for this use.
- ☐ Ventilation equipment is accessible for inspection, maintenance, repair and cleaning.
- ☐ Ductwork is properly supported and joints sealed.
- ☐ Outdoor air supply is from a "clean air" location.
- ☐ Principal and supplemental exhaust fans can meet minimum total ventilation capacity requirement.
- ☐ Centrally-located manual switch operates principal exhaust fan. Furnace fan operates when principal exhaust fan on.
- ☐ Each exhaust duct has a backdraft damper. Either the backdraft damper or a rodent screen located at outside wall.
- ☐ Outdoor air supply connection to furnace return is at least 3 m (10 feet) upstream of furnace unless air is supplied through an acceptable mixing device. Outdoor air supply connection is downstream of all return air branch connections.

GOOD PRACTICE

- ☐ Ducts slope to exterior to prevent dripback. Exhaust hoods located where icing not a problem.
- ☐ Fan vibration isolation mounting used.
- ☐ Outdoor air introduced so as to minimize complaints.
- ☐ Air flows adjusted and balanced to design flows.
- ☐ Ventilation system literature supplied to homeowner. System operation explained and demonstrated to homeowner.

VENTILATION SYSTEM SPECIFIER AND INSTALLER'S GUIDE TO OPTION 2

AUXILIARY SUPPLY FAN COUPLED TO A FORCED AIR HEATING SYSTEM

COMPONENT	CAPACITY
■ PRINCIPAL EXHAUST SYSTEM	
• Exhausts from kitchen and/or bathrooms or other central location to outdoors. • Capable of continuous operation. • Controlled by centrally-located manual switch. May also have automatic control(s).	Principal exhaust capacity at least 50 per cent of minimum Total Ventilation Capacity.* If it is more than 75 per cent of minimum Total Ventilation Capacity, provide controls to adjust flow to within 10 per cent of the lower limit.
■ OUTDOOR AIR SUPPLY SYSTEM	
• Auxiliary supply fan supplies outdoor air to furnace return plenum. • Furnace fan distributes outdoor air. • Controls operate auxiliary supply fan and furnace fan when principal exhaust operates.	• Auxiliary supply fan sized to match the principal exhaust fan flow rate. • Fans handling untempered outdoor air must be designated for such use by the fan manufacturer.
■ SUPPLEMENTAL EXHAUST SYSTEM	
• Supplemental exhaust required in each bathroom not served by principal exhaust. • Supplemental exhaust required in kitchen if principal exhaust serves any other area. • Controlled by manual switch in room served. May also have automatic control.	• 25 L/s (50 cfm) from each bathroom or water closet, if required. • 50 L/s (105 cfm) from kitchen, if required. • Sum of principal exhaust and all supplemental exhausts must equal or exceed minimum Total Ventilation Capacity.*
■ MAKE-UP AIR SYSTEMS	
• Make-up air fan required for any device which exhausts over 75 L/s (160 cfm)...IF soil gas is deemed to be a problem but a soil gas mitigation system is not installed...OR a fuel-burning appliance which is vented through a chimney is present.** • Controlled to operate with exhaust device.	• Minimum make-up air fan capacity equals exhaust flow of device minus 75 L/s (160 cfm). • Maximum make-up air fan capacity equals exhaust flow of the device. • Make-up air must be tempered if introduced into normally occupied spaces. • Fans handling untempered outdoor air must be designated for such use by the fan manufacturer.
■ COMBUSTION AIR SYSTEMS	
• Combustion air may be required for vented combustion appliances. Ventilation and makeup air systems are not considered to provide combustion air.	• Size as per respective code (i.e. gas, oil, solid fuel, etc.).

* Minimum Total Ventilation Capacity is the sum of:
30 L/s (65 cfm) total for the master bedroom, kitchen, dining, living and the first bathroom,
5 L/s (10 cfm) for each additional habitable room, excluding the furnace room, storage areas, entrances and corridors,
10 L/s (20 cfm) for an unfinished basement, 5 L/s (10 cfm) if the unfinished area is less than 2/3 total basement floor area.

** If all fuel burning appliances which are vented through a chimney are solid-fuel burning, this requirement can be ignored if CO detectors/alarms are installed in each room with a solid-fuel burning appliance installed.

OPTION 2 ▪ AUXILIARY SUPPLY FAN COUPLED TO A FORCED AIR HEATING SYSTEM

1 Combustion air supply required for each vented combustion appliance, including fireplaces and woodstoves. Ventilation and make-up air are not combustion air.

2 Install a carbon monoxide detector/alarm in each room containing a solid-fuel burning appliance with doors that do not substantially close off the firebox. If doors substantially close off the firebox and make-up air system(s) are installed, a CO detector/alarm is not required in that room.

3 Provide make-up air for each device which exhausts more than 75 L/s (160 cfm) if soil gas is deemed to be a problem, or if non-solid-fuel burning appliances are vented through a chimney. Make-up air system must reduce net exhaust of device to less than 75 L/s (160 cfm).

4 Make-up air fan controlled to operate when the device served operates. Make-up air heated to at least 12°C unless delivered to a normally unoccupied area in dwelling.

As of 1995, powered make-up air systems (fan, tempering devices) were not readily available. Ensure that any components used in these systems are designed for operation with cold air.

5 Opening windows provide natural ventilation to each habitable space, otherwise provide 1.0 ACH mechanical ventilation (0.5 ACH if space is air-conditioned), designed in accordance with Section 9.33.

6 Kitchen exhaust intake (except range hood) located in ceiling or wall within 300 mm (12 inches) of ceiling. Duct accessible for cleaning unless intake is equipped with a readily serviceable grease filter.

7 50 L/s (105 cfm) supplemental exhaust from kitchen if principal exhaust serves any room other than kitchen. Fan controlled by manual switch in kitchen. Maximum 3.5 sone rating for supplemental kitchen exhaust fans which help meet the total ventilation capacity.

8 25 L/s (50 cfm) supplemental exhaust from each bathroom not served by principal exhaust. Fan controlled by manual switch in bathroom served. Maximum 2.0 sone rating for supplemental bathroom exhaust fans which help meet the total ventilation capacity.

9 Size supplemental exhaust ducts up to 9 m (30 feet) long and not exceeding four elbows, using Table 9.32.3.5; otherwise, use Section 9.33.

10 Ventilation equipment in unheated spaces installed to avoid condensation on fans and motors as per manufacturer's instructions. Insulate exhaust ducts in unheated spaces to RSI 0.5 (R 2.8).

11 Locate outdoor air intakes well away from contamination sources (e.g., automobile exhaust, building exhaust) and at least 900 mm (36 inches) from combustion appliance vents, oil fill pipes, gas meters, etc. Intake hoods are labelled for easy identification and accessible for service.

12 Exhaust ducts do not discharge into heated or unheated enclosed spaces.

13 Centrally-located manual switch labelled "Ventilation Fan" activates principal exhaust fan, auxiliary supply fan and furnace circulation fan.

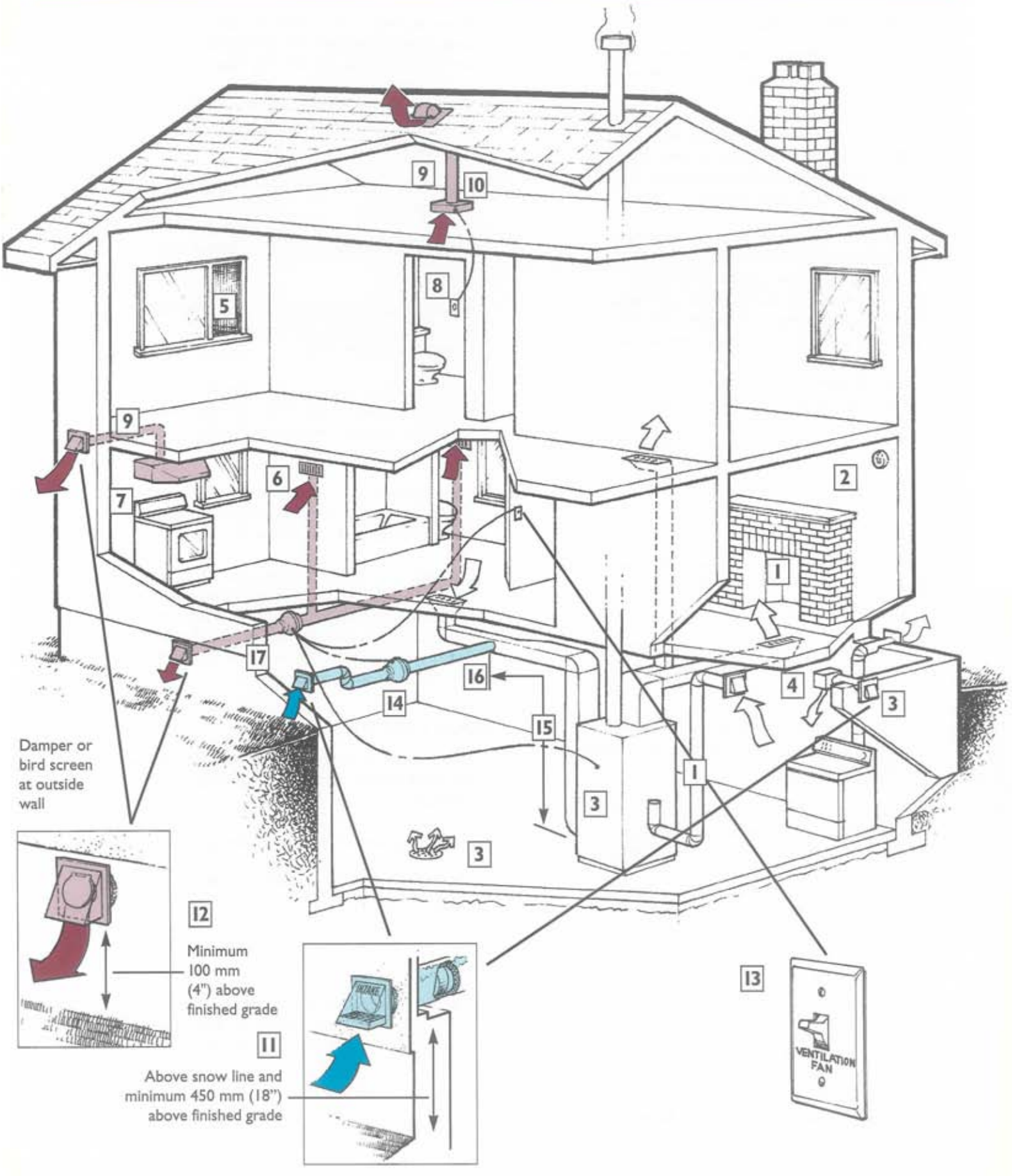
14 Auxiliary supply fan designed for handling untempered outdoor air. Maximum noise rating 2.0 sones.

15 Outdoor air supply duct directly connected to return plenum downstream of all return branch ducts, and at least 3 m (10 feet) upstream of furnace unless connected through an acceptable mixing device.

16 Size outdoor air supply ducts up to 8 m (26 feet) long and not exceeding three elbows using Table 9.32.3.6.B; otherwise, use Section 9.33. Insulate ducts carrying untempered outdoor air through heated spaces to at least RSI 0.5 (R 2.8).

17 Size principal exhaust ducts up to 12 m (40 feet) long and not exceeding four elbows, using Table 9.32.3.4; otherwise, use Section 9.33.

Performance, reliability and safety testing was not available for this system option at the time of publication.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Damper or bird screen at outside wall
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Minimum 100 mm (4") above finished grade
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Above snow line and minimum 450 mm (18") above finished grade
13
VENTILATION FAN

Inspection Checklist

OPTION 2

NBC REQUIREMENTS

- ☐ Combustion air provided for vented combustion appliances as required by fuel codes.
- ☐ CO sensor with audible alarm meeting CAN/CGA-6.19-M installed in each room with a solid-fuel burning appliance not equipped with airtight doors.
- ☐ Make-up air provided for devices which exhaust more than 75 L/s if soil gas is a problem, or if non-solid-fuel burning appliances are vented through a chimney. Make-up air tempered to at least 12 °C or delivered to a normally unoccupied area.
- ☐ Ductwork sized using Section 9.32 tables or detailed design according to Section 9.33. In any case, ductwork not smaller than recommended in manufacturer's literature.
- ☐ Fans are HVI-certified and meet NBC requirements for airflow capacity and sound ratings.
- ☐ Kitchen and all bathrooms have exhaust. Supplemental exhaust fans have manual control in room served.
- ☐ Kitchen exhaust duct is non-combustible. Duct has grease filter installed at intake or is accessible for cleaning.
- ☐ Exhaust ducts discharge directly to outdoors. Outlets at least 100 mm (4 inches) above finished grade.
- ☐ Outdoor air intake hoods have corrosion-resistant screen to keep out small animals. If mesh is less than 6 mm (1/4 inch), gross area is three times the duct area and is accessible and removable for cleaning without special tools.
- ☐ Outdoor air intake and exhaust openings are protected from weather.
- ☐ Outdoor air intakes are above snow line and at least 450 mm (18 inches) above finished grade and accessible for cleaning.
- ☐ All ducts which carry cold air through conditioned spaces or warm air through unconditioned spaces are insulated and have vapour barrier on warm side.
- ☐ Fans, motors and heaters handling untempered outdoor air designated by the manufacturer for this use.
- ☐ Ventilation equipment is accessible for inspection, maintenance, repair and cleaning.
- ☐ Ductwork is properly supported and joints sealed.
- ☐ Outdoor air supply is from a "clean air" location.
- ☐ Principal and supplemental exhaust fans can meet minimum total ventilation capacity requirement.
- ☐ Centrally-located manual switch operates principal exhaust fan. Furnace fan and auxiliary supply fan operate when principal exhaust fan on.
- ☐ Each exhaust duct has a backdraft damper. Either the backdraft damper or a rodent screen located at outside wall.
- ☐ Outdoor air supply connection to furnace return is at least 3 m (10 feet) upstream of furnace unless air is supplied through an acceptable mixing device. Outdoor air supply connection is downstream of all return air branch connections.

GOOD PRACTICE

- ☐ Ducts slope to exterior to prevent dripback. Exhaust hoods located where icing not a problem.
- ☐ Fan vibration isolation mounting used.
- ☐ Outdoor air introduced so as to minimize complaints.
- ☐ Air flows adjusted and balanced to design flows.
- ☐ Ventilation system literature supplied to homeowner. System operation explained and demonstrated to homeowner.

VENTILATION SYSTEM SPECIFIER AND INSTALLER'S GUIDE TO OPTION 3

HEAT RECOVERY VENTILATOR (HRV) COUPLED TO A FORCED AIR HEATING SYSTEM – EXTENDED PRINCIPAL EXHAUST DUCTWORK

COMPONENT	CAPACITY
■ PRINCIPAL EXHAUST AND OUTDOOR AIR SUPPLY SYSTEMS • An HRV provides the principal exhaust and outdoor air supply functions. • HRV exhausts from kitchen and/or bathrooms or other central location to outdoors. • HRV supplies outdoor air to return air plenum of forced air heating system, furnace fan distributes it. May also have automatic control(s). • HRV operated by centrally-located manual control. May also have automatic controls. • Controls operate furnace fan when HRV operates.	HRV airflow capacity, at least 50 per cent of Minimum Total Ventilation Capacity*. If capacity is more than 75 per cent of Minimum Total Ventilation Capacity, provide controls to adjust flow to within 10 per cent of the lower limit. • Air flows balanced to within 10 per cent of each other. • HRV performance is HVI certified to CAN/CSA-439 "Rating the Performance of Heat Recovery Ventilators".
■ SUPPLEMENTAL EXHAUST SYSTEM • Supplemental exhaust required in each bathroom not served by principal exhaust. • Supplemental exhaust required in kitchen if principal exhaust serves any other area. • Controlled by manual switch in room served. May also have automatic control.	• 25 L/s (50 cfm) from each bathroom or water closet, if required. • 50 L/s (105 cfm) from kitchen, if required. • Sum of principal exhaust and all supplemental exhausts must equal or exceed minimum Total Ventilation Capacity.*
■ MAKE-UP AIR SYSTEMS • Make-up air fan required for any device which exhausts over 75 L/s (160 cfm)...IF soil gas is deemed to be a problem but a soil gas mitigation system is not installed...OR a fuel-burning appliance which is vented through a chimney is present.** • Controlled to operate with exhaust device.	• Minimum make-up air fan capacity equals exhaust flow of device minus 75 L/s (160 cfm). • Maximum make-up air fan capacity equals exhaust flow of the device. • Make-up air must be tempered if introduced into normally occupied spaces. • Fans handling untempered outdoor air must be designated for such use by the fan manufacturer.
■ COMBUSTION AIR SYSTEMS • Combustion air may be required for vented combustion appliances. Ventilation and makeup air systems are not considered to provide combustion air.	• Size as per respective code (i.e. gas, oil, solid fuel, etc.).

* Minimum Total Ventilation Capacity is the sum of:
30 L/s (65 cfm) total for the master bedroom, kitchen, dining, living and the first bathroom,
5 L/s (10 cfm) for each additional habitable room, excluding the furnace room, storage areas, entrances and corridors,
10 L/s (20 cfm) for an unfinished basement, 5 L/s (10 cfm) if the unfinished area is less than 2/3 total basement floor area.

** If all fuel burning appliances which are vented through a chimney are solid-fuel burning, this requirement can be ignored if CO detectors/alarms are installed in each room with a solid-fuel burning appliance installed.

OPTION 3 ▪ HEAT RECOVERY VENTILATOR (HRV) COUPLED TO A FORCED AIR HEATING SYSTEM – EXTENDED PRINCIPAL EXHAUST DUCTWORK

1 Combustion air supply required for each vented combustion appliance, including fireplaces and woodstoves. Ventilation and make-up air are not combustion air.

2 Install a carbon monoxide detector/alarm in each room containing a solid-fuel burning appliance with doors that do not substantially close off the firebox. If doors substantially close off the firebox and make-up air system(s) are installed, a CO detector/alarm is not required in that room.

3 Provide make-up air for each device which exhausts more than 75 L/s (160 cfm) if soil gas is deemed to be a problem, or if non-solid-fuel burning appliances are vented through a chimney. Make-up air system must reduce net exhaust of device to less than 75 L/s (160 cfm).

4 Make-up air fan controlled to operate when the device served operates. Make-up air heated to at least 12°C unless delivered to a normally unoccupied area in dwelling.

As of 1995, powered make-up air systems (fan, tempering devices) were not readily available. Ensure that any components used in these systems are designed for operation with cold air.

5 Opening windows provide natural ventilation to each habitable space, otherwise provide 1.0 ACH mechanical ventilation (0.5 ACH if space is air-conditioned), designed in accordance with Section 9.33.

6 Kitchen exhaust intake (except range hood) located in ceiling or wall within 300 mm (12 inches) of ceiling. Duct accessible for cleaning unless intake is equipped with a readily serviceable grease filter.

7 50 L/s (105 cfm) supplemental exhaust from kitchen if principal exhaust serves any room other than kitchen. Fan controlled by manual switch in kitchen. Maximum 3.5 sone rating for supplemental kitchen exhaust fans which help meet the total ventilation capacity.

8 25 L/s (50 cfm) supplemental exhaust from each bathroom not served by principal exhaust. Fan controlled by manual switch in bathroom served. Maximum 2.0 sone rating for supplemental bathroom exhaust fans which help meet the total ventilation capacity.

9 Size supplemental exhaust ducts up to 9 m (30 feet) long and not exceeding four elbows, using Table 9.32.3.5; otherwise, use Section 9.33.

10 Ventilation equipment in unheated spaces installed to avoid condensation on fans and motors as per manufacturer's instructions. Insulate exhaust ducts in unheated spaces to RSI 0.5 (R 2.8).

11 Locate outdoor air intakes well away from contamination sources (e.g., automobile exhaust, building exhaust) and at least 900 mm (36 inches) from combustion appliance vents, oil fill pipes, gas meters, etc. Intake hoods are labelled for easy identification and accessible for service.

12 Exhaust ducts do not discharge into heated or unheated enclosed spaces.

13 Centrally-located manual switch labelled "Ventilation Fan" activates HRV and furnace circulation fan.

14 Outdoor air supply duct from HRV directly connected to return plenum downstream of all return branch ducts, and at least 3 m (10 feet) upstream of furnace unless connected through an acceptable mixing device.

15 HRV performance is HVI-tested/certified to CAN\CSA-C439. HRV airflows balanced to within 10 per cent of each other at reference exhaust flow rate.

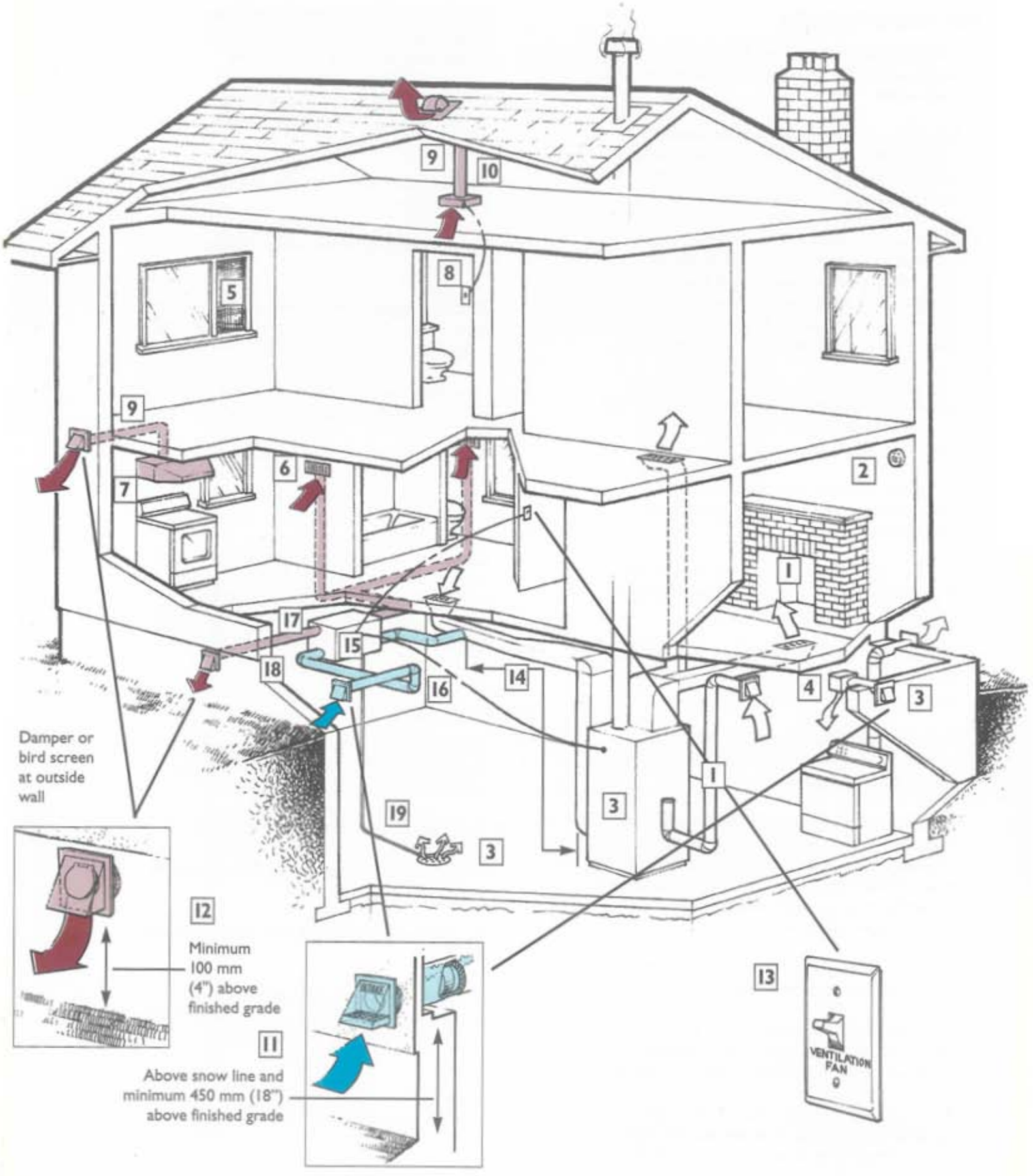
16 Size HRV supply ducts up to 8 m (26 feet) long and not exceeding three elbows, using Table 9.32.3.6.B; otherwise, use Section 9.33.

17 Size HRV exhaust ducts up to 12 m (40 feet) long and not exceeding four elbows, but not less than 6 m (20 feet) and two elbows, using Table 9.32.3.4; otherwise, use Section 9.33.

18 Insulate ducts carrying cold air through heated spaces to at least RSI 0.5 (R 2.8). Insulate HRV cold side supply ducts over 3 m (10 feet) to at least:

Winter Design Temp. °C	Insulation Required RSI	R
-12 to –17	0.9	5.1
-18 to –24	1.2	6.8
-25 to –29	1.4	8.0
-30 to –34	1.8	10.2
-35 or colder	2.1	12.0

19 Provide condensate drain as per manufacturer's instructions; otherwise, install a 1/2 inch drain, sloped for flow, complete with a trap or condensate pump.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Damper or bird screen at outside wall
12
Minimum 100 mm (4") above finished grade
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Above snow line and minimum 450 mm (18") above finished grade
13
VENTILATION FAN

Inspection Checklist

OPTION 3

NBC REQUIREMENTS

- ☐ Combustion air provided for vented combustion appliances as required by fuel codes.
- ☐ CO sensor with audible alarm meeting CAN/CGA-6.19-M installed in each room with a solid-fuel burning appliance not equipped with airtight doors.
- ☐ Make-up air provided for devices which exhaust more than 75 L/s if soil gas is a problem, or if non-solid-fuel burning appliances are vented through a chimney. Make-up air tempered to at least 12 °C or delivered to a normally unoccupied area.
- ☐ Ductwork sized using Section 9.32 tables or detailed design according to Section 9.33. In any case, ductwork not smaller than recommended in manufacturer's literature.
- ☐ Fans are HVI-certified and meet NBC requirements for airflow capacity and sound ratings.
- ☐ Kitchen and all bathrooms have exhaust. Supplemental exhaust fans have manual control in room served.
- ☐ Kitchen exhaust duct is non-combustible. Duct has grease filter installed at intake or is accessible for cleaning.
- ☐ Exhaust ducts discharge directly to outdoors. Outlets at least 100 mm (4 inches) above finished grade.
- ☐ Outdoor air intake hoods have corrosion-resistant screen to keep out small animals. If mesh is less than 6 mm (1/4 inch), gross area is three times the duct area and is accessible and removable for cleaning without special tools.
- ☐ Outdoor air intake and exhaust openings are protected from weather.
- ☐ Outdoor air intakes are above snow line and at least 450 mm (18 inches) above finished grade and accessible for cleaning.
- ☐ All ducts which carry cold air through conditioned spaces or warm air through unconditioned spaces are insulated and have vapour barrier on warm side.
- ☐ Fans, motors and heaters handling untempered outdoor air designated by the manufacturer for this use.
- ☐ Ventilation equipment is accessible for inspection, maintenance, repair and cleaning.
- ☐ Ductwork is properly supported and joints sealed.
- ☐ Outdoor air supply is from a "clean air" location.
- ☐ HRV and supplemental exhaust fans can meet minimum total ventilation capacity requirement.
- ☐ Centrally-located manual switch operates HRV. Furnace fan operates when HRV on.
- ☐ Each exhaust duct has a backdraft damper (not required for HRVs). Either a backdraft damper or rodent screen located at the outside wall.
- ☐ Outdoor air supply connection to furnace return is at least 3 m (10 feet) upstream of furnace unless air is supplied through an acceptable mixing device. Outdoor air supply connection is downstream of all return air branch connections.

GOOD PRACTICE

- ☐ Ducts slope to exterior to prevent dripback. Exhaust hoods located where icing not a problem.
- ☐ Fan vibration isolation mounting used.
- ☐ Outdoor air introduced so as to minimize complaints.
- ☐ Air flows adjusted and balanced to design flows.
- ☐ Ventilation system literature supplied to homeowner. System operation explained and demonstrated to homeowner.

VENTILATION SYSTEM SPECIFIER AND INSTALLER'S GUIDE TO OPTION 4

HEAT RECOVERY VENTILATOR (HRV) COUPLED TO A FORCED AIR HEATING SYSTEM – SIMPLIFIED PRINCIPAL EXHAUST DUCTWORK

COMPONENT	CAPACITY
■ PRINCIPAL EXHAUST AND OUTDOOR AIR SUPPLY SYSTEMS	
• An HRV provides the principal exhaust and outdoor air supply functions. • HRV draws general exhaust from furnace return air duct. • HRV supplies outdoor air to the return at least one meter (40 inches) downstream of the exhaust connection and the furnace fan distributes it. • HRV operated by centrally-located manual control. May also have automatic controls. • Controls operate furnace fan when HRV operates.	HRV airflow capacity, at least 50 per cent of Minimum Total Ventilation Capacity.* If capacity is more than 75 per cent of Minimum Total Ventilation Capacity, provide controls to adjust flow to within 10 per cent of the lower limit. • Air flows balanced to within 10 per cent of each other. • HRV performance is HVI certified to CAN/CSA-439 "Rating the Performance of Heat Recovery Ventilators".
■ SUPPLEMENTAL EXHAUST SYSTEM	
• Supplemental exhaust required in each bathroom and in kitchen. • Controlled by manual switch in room served. May also have automatic control.	• 25 L/s from each bathroom or water closet. • 50 L/s from kitchen. • Sum of principal exhaust and all supplemental exhausts must equal or exceed Total Ventilation Capacity.**
■ MAKE-UP AIR SYSTEMS	
• Make-up air fan required for any device which exhausts over 75 L/s (160 cfm)...IF soil gas is deemed to be a problem but a soil gas mitigation system is not installed...OR a fuel-burning appliance which is vented through a chimney is present.** • Controlled to operate with exhaust device.	• Minimum make-up air fan capacity equals exhaust flow of device minus 75 L/s (160 cfm). • Maximum make-up air fan capacity equals exhaust flow of the device. • Make-up air must be tempered if introduced into normally occupied spaces. • Fans handling untempered outdoor air must be designated for such use by the fan manufacturer.
■ COMBUSTION AIR SYSTEMS	
• Combustion air may be required for vented combustion appliances. Ventilation and makeup air systems are not considered to provide combustion air.	• Size as per respective code (i.e. gas, oil, solid fuel, etc.).

* Minimum Total Ventilation Capacity is the sum of:
30 L/s (65 cfm) total for the master bedroom, kitchen, dining, living and the first bathroom,
5 L/s (10 cfm) for each additional habitable room, excluding the furnace room, storage areas, entrances and corridors,
10 L/s (20 cfm) for an unfinished basement, 5 L/s (10 cfm) if the unfinished area is less than 2/3 total basement floor area.

** If all fuel burning appliances which are vented through a chimney are solid-fuel burning, this requirement can be ignored if CO detectors/alarms are installed in each room with a solid-fuel burning appliance installed.

OPTION 4 ▪ HEAT RECOVERY VENTILATOR (HRV) COUPLED TO A FORCED AIR HEATING SYSTEM – SIMPLIFIED PRINCIPAL EXHAUST DUCTWORK

1 Combustion air supply required for each vented combustion appliance, including fireplaces and woodstoves. Ventilation and make-up air are not combustion air.

2 Install a carbon monoxide detector/alarm in each room containing a solid-fuel burning appliance with doors that do not substantially close off the firebox. If doors substantially close off the firebox and make-up air system(s) are installed, a CO detector/alarm is not required in that room.

3 Provide make-up air for each device which exhausts more than 75 L/s (160 cfm) if soil gas is deemed to be a problem, or if non-solid-fuel burning appliances are vented through a chimney. Make-up air system must reduce net exhaust of device to less than 75 L/s (160 cfm).

4 Make-up air fan controlled to operate when the device served operates. Make-up air heated to at least 12°C unless delivered to a normally unoccupied area in dwelling.

As of 1995, powered make-up air systems (fan, tempering devices) were not readily available. Ensure that any components used in these systems are designed for operation with cold air.

5 Opening windows provide natural ventilation to each habitable space, otherwise provide 1.0 ACH mechanical ventilation (0.5 ACH if space is air-conditioned), designed in accordance with Section 9.33.

6 Kitchen exhaust intake (except range hood) located in ceiling or wall within 300 mm (12 inches) of ceiling. Duct accessible for cleaning unless intake is equipped with a readily serviceable grease filter.

7 50 L/s (105 cfm) supplemental exhaust from kitchen which may be provided either through an independant exhaust fan or vented range hood. Fan controlled by manual switch in kitchen. Maximum 3.5 sone rating for supplemental kitchen exhaust fans which help meet the total ventilation capacity.

8 25 L/s (50 cfm) supplemental exhaust from each bathroom. Fan controlled by manual switch in bathroom served. Maximum 2.0 sone rating for supplemental bathroom exhaust fans which help meet the total ventilation capacity.

9 Size supplemental exhaust ducts up to 9 m (30 feet) long and not exceeding four elbows, using Table 9.32.3.5; otherwise, use Section 9.33.

10 Ventilation equipment in unheated spaces installed to avoid condensation on fans and motors as per manufacturer's instructions. Insulate exhaust ducts in unheated spaces to RSI 0.5 (R 2.8).

11 Locate outdoor air intakes well away from contamination sources (e.g., automobile exhaust, building exhaust) and at least 900 mm (36 inches) from combustion appliance vents, oil fill pipes, gas meters, etc. Intake hoods are labelled for easy identification and accessible for service.

12 Exhaust ducts do not discharge into heated or unheated enclosed spaces.

13 Centrally-located manual switch labelled "Ventilation Fan" activates HRV and furnace circulation fan.

14 Outdoor air supply duct from HRV directly connected to return plenum downstream of all return branch ducts, and at least 3 m (10 feet) upstream of furnace unless connected through an acceptable mixing device.

15 HRV performance is HVI-tested/certified to CAN\CSA-C439. HRV airflows balanced to within 10 per cent of each other at reference exhaust flow rate.

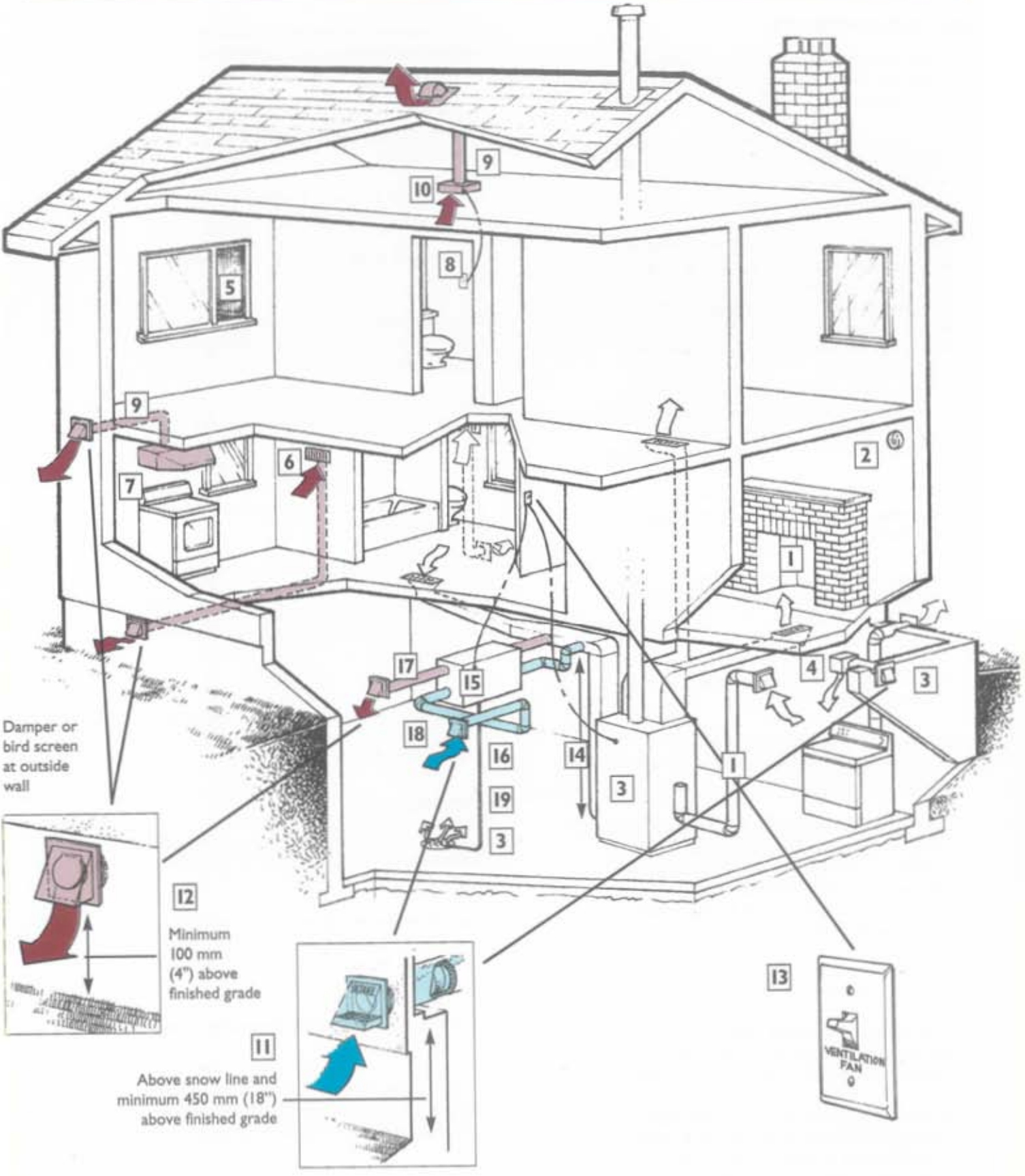
16 Size HRV supply ducts up to 8 m (26 feet) long and not exceeding three elbows, using Table 9.32.3.6.B; otherwise, use Section 9.33.

17 Size HRV exhaust ducts up to 12 m (40 feet) long and not exceeding four elbows, but not less than 6 m (20 feet) and two elbows, using Table 9.32.3.4; otherwise, use Section 9.33.

18 Insulate ducts carrying cold air through heated spaces to at least RSI 0.5 (R 2.8). Insulate HRV cold side supply ducts over 3 m (10 feet) to at least:

Winter Design Temp. °C	Insulation Required RSI	R
-12 to –17	0.9	5.1
-18 to –24	1.2	6.8
-25 to –29	1.4	8.0
-30 to –34	1.8	10.2
-35 or colder	2.1	12.0

19 Provide condensate drain as per manufacturer's instructions; otherwise, install a 1/2 inch drain, sloped for flow, complete with a trap or condensate pump.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3
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19
3
Damper or bird screen at outside wall
12
Minimum 100 mm (4") above finished grade
11
Above snow line and minimum 450 mm (18") above finished grade
13
VENTILATION FAN

Inspection Checklist

OPTION 4

NBC REQUIREMENTS

- ☐ Combustion air provided for vented combustion appliances as required by fuel codes.
- ☐ CO sensor with audible alarm meeting CAN/CGA-6.19-M installed in each room with a solid-fuel burning appliance not equipped with airtight doors.
- ☐ Make-up air provided for devices which exhaust more than 75 L/s if soil gas is a problem, or if non-solid-fuel burning appliances are vented through a chimney. Make-up air tempered to at least 12 °C or delivered to a normally unoccupied area.
- ☐ Ductwork sized using Section 9.32 tables or detailed design according to Section 9.33. In any case, ductwork not smaller than recommended in manufacturer's literature.
- ☐ Fans are HVI-certified and meet NBC requirements for airflow capacity and sound ratings.
- ☐ Kitchen and all bathrooms have exhaust. Supplemental exhaust fans have manual control in room served.
- ☐ Kitchen exhaust duct is non-combustible. Duct has grease filter installed at intake or is accessible for cleaning.
- ☐ Exhaust ducts discharge directly to outdoors. Outlets at least 100 mm (4 inches) above finished grade.
- ☐ Outdoor air intake hoods have corrosion-resistant screen to keep out small animals. If mesh is less than 6 mm (1/4 inch), gross area is three times the duct area and is accessible and removable for cleaning without special tools.
- ☐ Outdoor air intake and exhaust openings are protected from weather.
- ☐ Outdoor air intakes are above snow line and at least 450 mm (18 inches) above finished grade and accessible for cleaning.
- ☐ All ducts which carry cold air through conditioned spaces or warm air through unconditioned spaces are insulated and have vapour barrier on warm side.
- ☐ Fans, motors and heaters handling untempered outdoor air designated by the manufacturer for this use.
- ☐ Ventilation equipment is accessible for inspection, maintenance, repair and cleaning.
- ☐ Ductwork is properly supported and joints sealed.
- ☐ Outdoor air supply is from a "clean air" location.
- ☐ HRV and supplemental exhaust fans can meet minimum total ventilation capacity requirement.
- ☐ Centrally-located manual switch operates HRV. Furnace fan operates when HRV on.
- ☐ Each exhaust duct has a backdraft damper (not required for HRVs). Either a backdraft damper or rodent screen located at the outside wall.
- ☐ Outdoor air supply connection to furnace return is at least 3 m (10 feet) upstream of furnace unless air is supplied through an acceptable mixing device. Outdoor air supply connection is downstream of all return air branch connections.
- ☐ Principal exhaust connection to furnace return is at least one meter upstream of outdoor air supply connection.

GOOD PRACTICE

- ☐ Ducts slope to exterior to prevent dripback. Exhaust hoods located where icing not a problem.
- ☐ Fan vibration isolation mounting used.
- ☐ Outdoor air introduced so as to minimize complaints.
- ☐ Air flows adjusted and balanced to design flows.
- ☐ Ventilation system literature supplied to homeowner. System operation explained and demonstrated to homeowner.

VENTILATION SYSTEM SPECIFIER AND INSTALLER'S GUIDE TO

OPTION 5

AUXILIARY SUPPLY FAN SYSTEM NOT COUPLED TO A FORCED AIR HEATING SYSTEM

COMPONENT	CAPACITY
■ PRINCIPAL EXHAUST FAN(S)	
• Exhausts from kitchen and/or bathrooms or other central location to outdoors. • Capable of continuous operation. • Controlled by centrally-located manual switch. May also have automatic control(s).	Principal exhaust capacity at least 50 per cent of minimum Total Ventilation Capacity.* If it is more than 75 per cent of minimum Total Ventilation Capacity, provide controls to adjust flow to within 10 per cent of the lower limit.
■ OUTDOOR AIR SUPPLY SYSTEM	
• Auxiliary supply fan supplies outdoor air directly to each bedroom, to each floor without a bedroom and to the living area if there are no floors without a bedroom. • Controls operate auxiliary supply fan when principal exhaust operates.	• Auxiliary supply fan sized to match the principal exhaust fan flow rate. • Outdoor air is heated to at least 12°C before being delivered through grilles which promote diffusion across the ceiling. • Fans handling untempered outdoor air must be designated for such use by the fan manufacturer.
■ SUPPLEMENTAL EXHAUST SYSTEM	
• Supplemental exhaust required in each bathroom not served by principal exhaust. • Supplemental exhaust required in kitchen if principal exhaust serves any other area. • Controlled by manual switch in room served. May also have automatic control.	• 25 L/s from each bathroom or water closet, if required. • 50 L/s from kitchen, if required. • Sum of principal exhaust and all supplemental exhausts must equal or exceed Total Ventilation Capacity.**
■ MAKE-UP AIR SYSTEMS	
• Make-up air fan required for any device which exhausts over 75 L/s (160 cfm)...IF soil gas is deemed to be a problem but a soil gas mitigation system is not installed...OR a fuel-burning appliance which is vented through a chimney is present.** • Controlled to operate with exhaust device.	• Minimum make-up air fan capacity equals exhaust flow of device minus 75 L/s (160 cfm). • Maximum make-up air fan capacity equals exhaust flow of the device. • Make-up air must be tempered if introduced into normally occupied spaces. • Fans handling untempered outdoor air must be designated for such use by the fan manufacturer.
■ COMBUSTION AIR SYSTEMS	
• Combustion air may be required for vented combustion appliances. Ventilation and makeup air systems are not considered to provide combustion air.	• Size as per respective code (i.e. gas, oil, solid fuel, etc.).

* Minimum Total Ventilation Capacity is the sum of:
30 L/s (65 cfm) total for the master bedroom, kitchen, dining, living and the first bathroom,
5 L/s (10 cfm) for each additional habitable room, excluding the furnace room, storage areas, entrances and corridors,
10 L/s (20 cfm) for an unfinished basement, 5 L/s (10 cfm) if the unfinished area is less than 2/3 total basement floor area.

** If all fuel burning appliances which are vented through a chimney are solid-fuel burning, this requirement can be ignored if CO detectors/alarms are installed in each room with a solid-fuel burning appliance installed.

OPTION 5 ▪ AUXILIARY SUPPLY FAN SYSTEM NOT COUPLED TO A FORCED AIR HEATING SYSTEM

1 Combustion air supply required for each vented combustion appliance, including fireplaces and woodstoves. Ventilation and make-up air are not combustion air.

2 Install a carbon monoxide detector/alarm in each room containing a solid-fuel burning appliance with doors that do not substantially close off the firebox. If doors substantially close off the firebox and make-up air system(s) are installed, a CO detector/alarm is not required in that room.

3 Provide make-up air for each device which exhausts more than 75 L/s (160 cfm) if soil gas is deemed to be a problem, or if non-solid-fuel burning appliances are vented through a chimney. Make-up air system must reduce net exhaust of device to less than 75 L/s (160 cfm).

4 Make-up air fan controlled to operate when the device served operates. Make-up air heated to at least 12°C unless delivered to a normally unoccupied area in dwelling.

As of 1995, powered make-up air systems (fan, tempering devices) were not readily available. Ensure that any components used in these systems are designed for operation with cold air.

5 Opening windows provide natural ventilation to each habitable space, otherwise provide 1.0 ACH mechanical ventilation (0.5 ACH if space is air-conditioned), designed in accordance with Section 9.33.

6 Kitchen exhaust intake (except range hood) located in ceiling or wall within 300 mm (12 inches) of ceiling. Duct accessible for cleaning unless intake is equipped with a readily serviceable grease filter.

7 50 L/s (105 cfm) supplemental exhaust from kitchen if principal exhaust serves any room other than kitchen. Fan controlled by manual switch in kitchen. Maximum 3.5 sone rating for supplemental kitchen exhaust fans which help meet the total ventilation capacity.

8 25 L/s (50 cfm) supplemental exhaust from each bathroom not served by principal exhaust. Fan controlled by manual switch in bathroom served. Maximum 2.0 sone rating for supplemental bathroom exhaust fans which help meet the total ventilation capacity.

9 Size supplemental exhaust ducts up to 9 m (30 feet) long and not exceeding four elbows using Table 9.32.3.5; otherwise, use Section 9.33.

10 Ventilation equipment in unheated spaces installed to avoid condensation on fans and motors as per manufacturer's instructions. Insulate exhaust ducts in unheated spaces to RSI 0.5 (R 2.8).

11 Locate outdoor air intakes well away from contamination sources (e.g., automobile exhaust, building exhaust) and at least 900 mm (36 inches) from combustion appliance vents, oil fill pipes, gas meters, etc. Intake hoods are labelled for easy identification and accessible for service.

12 Exhaust ducts do not discharge into heated or unheated enclosed spaces.

13 Centrally-located manual switch labelled "Ventilation Fan" activates principal exhaust and auxiliary supply fans.

14 Door under-cuts (the greater of 1 mm/l/s and 15 mm) or transfer grilles allow air movement from supply to exhaust grilles.

15 Outdoor air ducted directly to each bedroom and to any storey without a bedroom. If there is no storey without a bedroom, supply to (or exhaust from) the principal living area. Exhaust must be via a principal exhaust fan serving not more than two other intakes.

16 Outdoor air supply outlets are located in ceiling or wall within 300 mm (12 inches) of ceiling and direct air across the ceiling. Air supplies have diffusers with adjustable balance stops or accessible dampers with locks and position indicators.

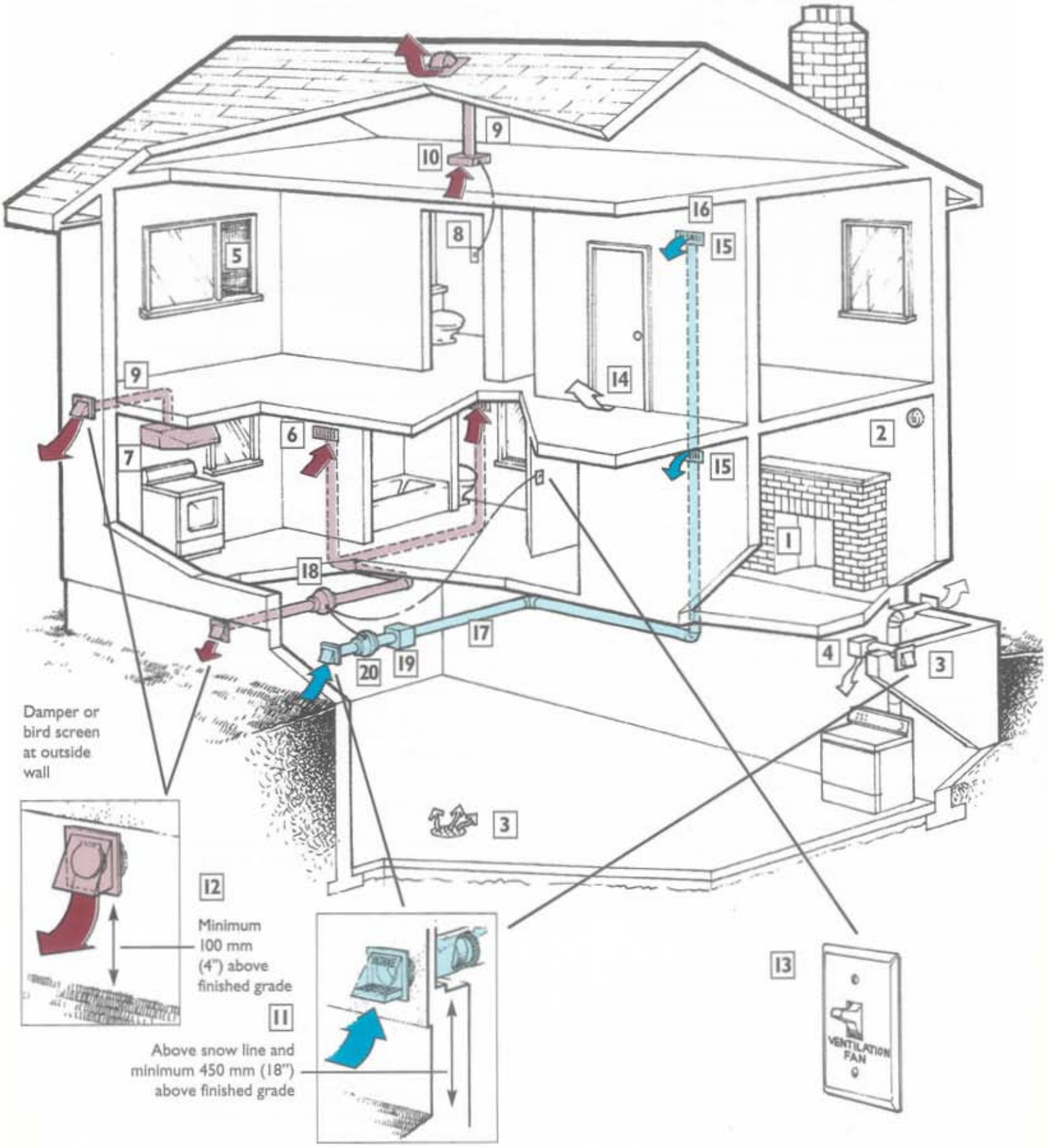
17 Size outdoor air supply ducts up to 21 m (70 feet) long and not exceeding eight fittings, using Table 9.32.3.7.B for trunk ducts, 9.32.3.7.C for branches; otherwise, use Section 9.33.

18 Size principal exhaust ducts up to 12 m (40 feet) long and not exceeding four elbows, using Table 9.32.3.4; otherwise use Section 9.33.

19 Preheat ventilation air to at least 12°C before delivering to living areas. Size preheater using Table 9.32.3.7.A or Section 9.33.

20 Insulate ducts carrying untempered outdoor air through heated spaces to at least RSI 0.5 (R 2.8).

Performance, reliability and safety testing was not available for this system option at the time of publication.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3
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19
Damper or bird screen at outside wall
3
12
Minimum 100 mm (4") above finished grade
11
Above snow line and minimum 450 mm (18") above finished grade
13
VENTILATION FAN

NBC REQUIREMENTS

- ☐ Combustion air provided for vented combustion appliances as required by fuel codes.
- ☐ CO sensor with audible alarm meeting CAN/CGA-6.19-M installed in each room with a solid-fuel burning appliance not equipped with airtight doors.
- ☐ Make-up air provided for devices which exhaust more than 75 L/s if soil gas is a problem, or if non-solid-fuel burning appliances are vented through a chimney. Make-up air tempered to at least 12 °C or delivered to a normally unoccupied area.
- ☐ Ductwork sized using Section 9.32 tables or detailed design according to Section 9.33. In any case, ductwork not smaller than recommended in manufacturer's literature.
- ☐ Fans are HVI-certified and meet NBC requirements for airflow capacity and sound ratings.
- ☐ Kitchen and all bathrooms have exhaust. Supplemental exhaust fans have manual control in room served.
- ☐ Kitchen exhaust duct is non-combustible. Duct has grease filter installed at intake or is accessible for cleaning.
- ☐ Exhaust ducts discharge directly to outdoors. Outlets at least 100 mm (4 inches) above finished grade.
- ☐ Outdoor air intake hoods have corrosion-resistant screen to keep out small animals. If mesh is less than 6 mm (1/4 inch), gross area is three times the duct area and is accessible and removable for cleaning without special tools.
- ☐ Outdoor air intake and exhaust openings are protected from weather.
- ☐ Outdoor air intakes are above snow line and at least 450 mm (18 inches) above finished grade and accessible for cleaning.
- ☐ All ducts which carry cold air through conditioned spaces or warm air through unconditioned spaces are insulated and have vapour barrier on warm side.
- ☐ Fans, motors and heaters handling untempered outdoor air designated by the manufacturer for this use.
- ☐ Ventilation equipment is accessible for inspection, maintenance, repair and cleaning.
- ☐ Ductwork is properly supported and joints sealed.
- ☐ Outdoor air supply is from a "clean air" location.
- ☐ Principal and supplemental exhaust fans can meet minimum total ventilation capacity requirement.
- ☐ Centrally-located manual switch operates principal exhaust fan. Auxiliary supply fan operates when principal exhaust fan is on.
- ☐ Each exhaust duct has a backdraft damper. Either the backdraft damper or a rodent screen located at outside wall.
- ☐ Ventilation air is heated to at least 12 °C and delivered through high wall or ceiling grilles. Branch supply ducts have diffusers with adjustable balance stops or in-duct balance dampers.
- ☐ Ventilation air is supplied directly to each bedroom, to any storey without a bedroom and, if there is no storey without a bedroom, to the principal living area. Transfer grilles or door undercuts allow air flow from closed rooms.

GOOD PRACTICE

- ☐ Ducts slope to exterior to prevent dripback. Exhaust hoods located where icing not a problem.
- ☐ Fan vibration isolation mounting used.
- ☐ Outdoor air introduced so as to minimize complaints.
- ☐ Air flows adjusted and balanced to design flows.
- ☐ Ventilation system literature supplied to homeowner. System operation explained and demonstrated to homeowner.

VENTILATION SYSTEM SPECIFIER
AND INSTALLER'S GUIDE TO

OPTION 6

HEAT RECOVERY VENTILATOR (HRV) NOT COUPLED TO A FORCED AIR HEATING SYSTEM

COMPONENT	CAPACITY
■ PRINCIPAL EXHAUST AND OUTDOOR AIR SUPPLY SYSTEMS • An HRV provides the principal exhaust and outdoor air supply functions. • HRV exhausts from kitchen and/or bathrooms or other central location to outdoors and supplies outdoor air directly to each bedroom, to each floor without a bedroom and to the living area if there are no floors without a bedroom. • HRV operated by centrally-located manual control. May also have automatic controls.	HRV airflow capacity, at least 50 per cent of Minimum Total Ventilation Capacity.* If capacity is more than 75 per cent of Minimum Total Ventilation Capacity, provide controls to adjust flow to within 10 per cent of the lower limit. • Air flows balanced to within 10 per cent of each other. • HRV performance is HVI certified to CAN/CSA-439 "Rating the Performance of Heat Recovery Ventilators".
■ SUPPLEMENTAL EXHAUSTS • Supplemental exhaust required in each bathroom not served by principal exhaust. • Supplemental exhaust required in kitchen if principal exhaust serves any other area. • Controlled by manual switch in room served. May also have automatic control.	• 25 L/s from each bathroom or water closet, if required. • 50 L/s from kitchen, if required. • Sum of principal exhaust and all supplemental exhausts must equal or exceed Total Ventilation Capacity.**
■ MAKE-UP AIR SYSTEMS • Make-up air fan required for any device which exhausts over 75 L/s (160 cfm)...IF soil gas is deemed to be a problem but a soil gas mitigation system is not installed...OR a fuel-burning appliance which is vented through a chimney is present.** • Controlled to operate with exhaust device.	• Minimum make-up air fan capacity equals exhaust flow of device minus 75 L/s (160 cfm). • Maximum make-up air fan capacity equals exhaust flow of the device. • Make-up air must be tempered if introduced into normally occupied spaces. • Fans handling untempered outdoor air must be designated for such use by the fan manufacturer.
■ COMBUSTION AIR SYSTEMS • Combustion air may be required for vented combustion appliances. Ventilation and makeup air systems are not considered to provide combustion air.	• Size as per respective code (i.e. gas, oil, solid fuel, etc.).

* Minimum Total Ventilation Capacity is the sum of:
30 L/s (65 cfm) total for the master bedroom, kitchen, dining, living and the first bathroom,
5 L/s (10 cfm) for each additional habitable room, excluding the furnace room, storage areas, entrances and corridors,
10 L/s (20 cfm) for an unfinished basement, 5 L/s (10 cfm) if the unfinished area is less than 2/3 total basement floor area.

** If all fuel burning appliances which are vented through a chimney are solid-fuel burning, this requirement can be ignored if CO detectors/alarms are installed in each room with a solid-fuel burning appliance installed.

OPTION 6 ▪ HEAT RECOVERY VENTILATOR (HRV) NOT COUPLED TO A FORCED AIR HEATING SYSTEM

1 Combustion air supply required for each vented combustion appliance, including fireplaces and woodstoves. Ventilation and make-up air are not combustion air.

2 Install a carbon monoxide detector/alarm in each room containing a solid-fuel burning appliance with doors that do not substantially close off the firebox. If doors substantially close off the firebox and make-up air system(s) are installed, a CO detector/alarm is not required in that room.

3 Provide make-up air for each device which exhausts more than 75 L/s (160 cfm) if soil gas is deemed to be a problem, or if non-solid-fuel burning appliances are vented through a chimney. Make-up air system must reduce net exhaust of device to less than 75 L/s (160 cfm).

4 Make-up air fan controlled to operate when the device served operates. Make-up air heated to at least 12°C unless delivered to a normally unoccupied area in dwelling.

As of 1995, powered make-up air systems (fan, tempering devices) were not readily available. Ensure that any components used in these systems are designed for operation with cold air.

5 Opening windows provide natural ventilation to each habitable space, otherwise provide 1.0 ACH mechanical ventilation (0.5 ACH if space is air-conditioned), designed in accordance with Section 9.33.

6 Kitchen exhaust intake (except range hood) located in ceiling or wall within 300 mm (12 inches) of ceiling. Duct accessible for cleaning unless intake is equipped with a readily serviceable grease filter.

7 50 L/s (105 cfm) supplemental exhaust from kitchen if principal exhaust serves any room other than kitchen. Fan controlled by manual switch in kitchen. Maximum 3.5 sone rating for supplemental kitchen exhaust fans which help meet the total ventilation capacity.

8 25 L/s (50 cfm) supplemental exhaust from each bathroom not served by principal exhaust. Fan controlled by manual switch in bathroom served. Maximum 2.0 sone rating for supplemental bathroom exhaust fans which help meet the total ventilation capacity.

9 Size supplemental exhaust ducts up to 9 m (30 feet) long and not exceeding four elbows, using Table 9.32.3.5; otherwise, use Section 9.33.

10 Ventilation equipment in unheated spaces installed to avoid condensation on fans and motors as per manufacturer's instructions. Insulate exhaust ducts in unheated spaces to RSI 0.5 (R 2.8).

11 Locate outdoor air intakes well away from contamination sources (e.g., automobile exhaust, building exhaust) and at least 900 mm (36 inches) from combustion appliance vents, oil fill pipes, gas meters, etc. Intake hoods are labelled for easy identification and accessible for service.

12 Exhaust ducts do not discharge into heated or unheated enclosed spaces.

13 Centrally-located manual switch labelled "Ventilation Fan" activates HRV.

14 Door under-cuts (the greater of 1 mm/l/s and 15 mm) or transfer grilles allow air movement from supply to exhaust grilles.

15 Outdoor air ducted directly to each bedroom and to any storey without a bedroom. If there is no storey without a bedroom, supply to (or exhaust from) the principal living area. Exhaust must be via a principal exhaust fan serving not more than two other intakes.

16 Outdoor air supply outlets are located in ceiling or wall within 300 mm (12 inches) of ceiling and direct air across the ceiling. Air supplies have diffusers with adjustable balance stops or accessible dampers with locks and position indicators.

17 For HRV supply ducts up to 21 m (70 feet) long and not exceeding eight fittings, size trunks using Table 9.32.3.7.B and branches, using 9.32.3.7; otherwise, use Section 9.33.

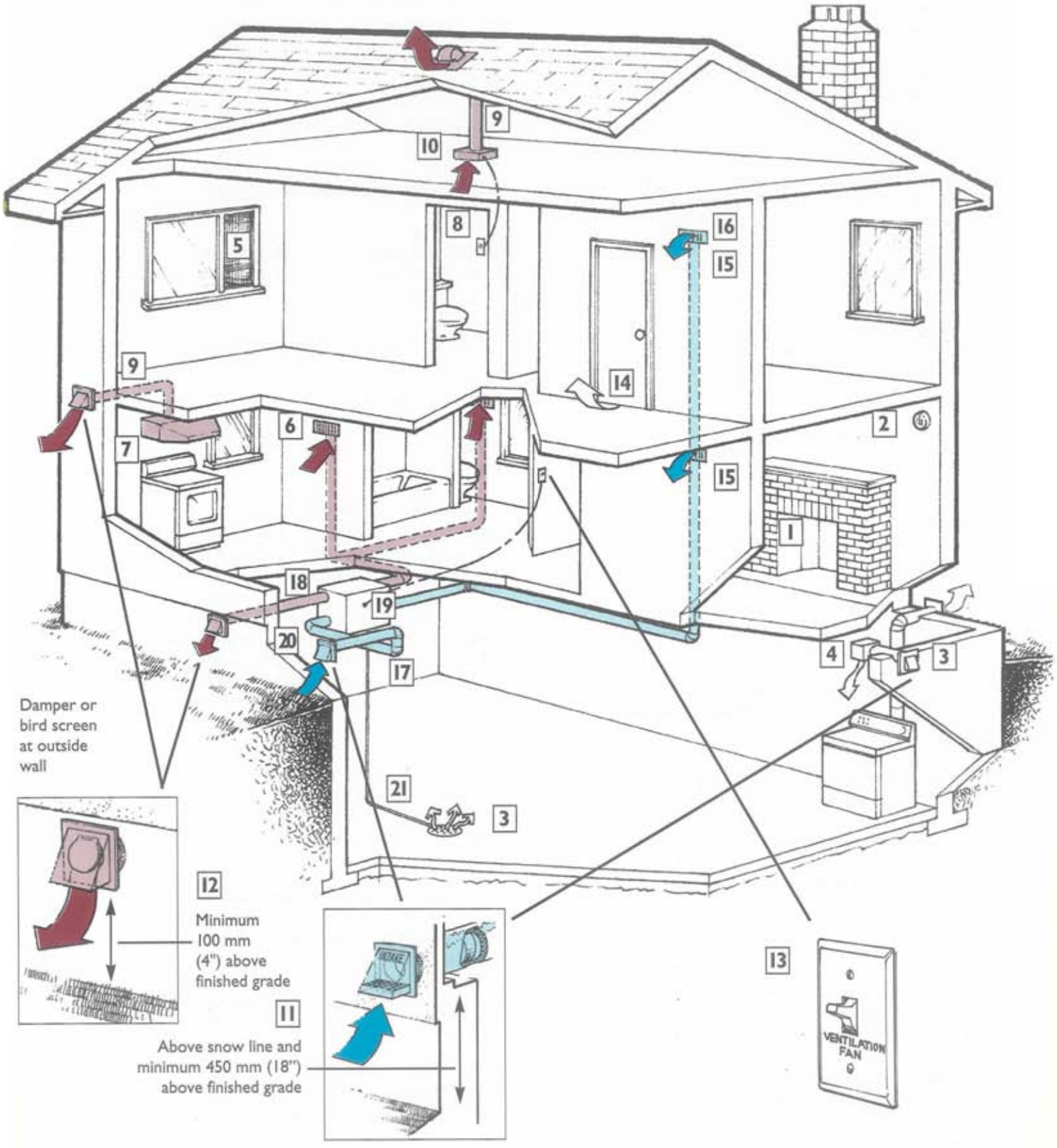
18 Size HRV exhaust ducts up to 12 m (40 feet) long and not exceeding four elbows, but not less than 6 m (20 feet) and two elbows, using Table 9.32.3.4; otherwise, use Section 9.33.

19 HRV performance is HVI-tested/certified to CAN/CSA-C439. HRV airflows balanced to within 10 per cent of each other at reference exhaust flow rate.

20 Insulate ducts carrying cold air through heated spaces to at least RSI 0.5 (R 2.8). Insulate HRV cold side supply ducts over 3 m (10 feet) to at least:

Winter Design Temp. °C	Insulation Required RSI	R
-12 to -17	0.9	5.1
-18 to -24	1.2	6.8
-25 to -29	1.4	8.0
-30 to -34	1.8	10.2
-35 or colder	2.1	12.0

21 Provide condensate drain as per manufacturer's instructions; otherwise, install a 1/2 inch drain, sloped for flow, complete with a trap or condensate pump.


Damper or bird screen at outside wall
12
Minimum 100 mm (4") above finished grade
11
Above snow line and minimum 450 mm (18") above finished grade
13
VENTILATION FAN

NBC REQUIREMENTS

- ☐ Combustion air provided for vented combustion appliances as required by fuel codes.
- ☐ CO sensor with audible alarm meeting CAN/CGA-6.19-M installed in each room with a solid-fuel burning appliance not equipped with airtight doors.
- ☐ Make-up air provided for devices which exhaust more than 75 L/s if soil gas is a problem, or if non-solid-fuel burning appliances are vented through a chimney. Make-up air tempered to at least 12 °C or delivered to a normally unoccupied area.
- ☐ Ductwork sized using Section 9.32 tables or detailed design according to Section 9.33. In any case, ductwork not smaller than recommended in manufacturer's literature.
- ☐ Fans are HVI-certified and meet NBC requirements for airflow capacity and sound ratings.
- ☐ Kitchen and all bathrooms have exhaust. Supplemental exhaust fans have manual control in room served.
- ☐ Kitchen exhaust duct is non-combustible. Duct has grease filter installed at intake or is accessible for cleaning.
- ☐ Exhaust ducts discharge directly to outdoors. Outlets at least 100 mm (4 inches) above finished grade.
- ☐ Outdoor air intake hoods have corrosion-resistant screen to keep out small animals. If mesh is less than 6 mm (1/4 inch), gross area is three times the duct area and is accessible and removable for cleaning without special tools.
- ☐ Outdoor air intake and exhaust openings are protected from weather.
- ☐ Outdoor air intakes are above snow line and at least 450 mm (18 inches) above finished grade and accessible for cleaning.
- ☐ All ducts which carry cold air through conditioned spaces or warm air through unconditioned spaces are insulated and have vapour barrier on warm side.
- ☐ Fans, motors and heaters handling untempered outdoor air designated by the manufacturer for this use.
- ☐ Ventilation equipment is accessible for inspection, maintenance, repair and cleaning.
- ☐ Ductwork is properly supported and joints sealed.
- ☐ Outdoor air supply is from a "clean air" location.
- ☐ HRV and supplemental exhaust fans can meet minimum total ventilation capacity requirement.
- ☐ Centrally-located manual switch operates HRV.
- ☐ Each exhaust duct has a backdraft damper (not required for HRVs). Either a backdraft damper or rodent screen located at the outside wall.
- ☐ Ventilation air delivered through high wall or ceiling grilles. Branch supply ducts have diffusers with adjustable balance stops or in-duct balance dampers.
- ☐ Ventilation air is supplied directly to each bedroom, to any storey without a bedroom and, if there is no storey without a bedroom, to the principal living area. Transfer grilles or door undercuts allow air flow from closed rooms.

GOOD PRACTICE

- ☐ Ducts slope to exterior to prevent dripback. Exhaust hoods located where icing not a problem.
- ☐ Fan vibration isolation mounting used.
- ☐ Outdoor air introduced so as to minimize complaints.
- ☐ Air flows adjusted and balanced to design flows.
- ☐ Ventilation system literature supplied to homeowner. System operation explained and demonstrated to homeowner.

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