State of MN
Energy Code Ventilation Review
for
2017
Energy Design Conference

By
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Dakota Supply Group
• In accordance with the Department of Labor and Industry’s statute 326.0981, Subd. 11,

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Overview

• Learn about MN Energy Code as it applies to Balanced Ventilation
• Ventilation system sizing
• Gain an understanding on the pros and cons of different duct designs
• Find out what the difference between HRV/ERV is
• A brief discussion on winter time humidity control
• Selection and operation of ventilation controls
• Why verification of operation (balancing airflows) is an important detail
• Some ideas on maintenance
OUTLINE

• ENERGY CODES
• SIZING AND DUCT DESIGN
• HRV AND ERV
• WINTER TIME ON HUMIDITY
• CONTROLS
• BALANCING
• MAINTENANCE
Methods of Ventilation

• **Continuous**: Sometimes referred to as general, central, or whole-house ventilation. Should be quiet, low volume, and continuous ventilation.

• **Intermittent**: Sometimes referred to as spot, local, or source point ventilation. Commonly used in bathroom, kitchen, laundry, hobby, and home office. Should remove excessive moisture and pollutants quickly.

Ideally, an airtight home designed with both continuous and Intermittent ventilation will contribute to a healthy and comfortable living environment for the entire family.
Ventilation Terminology

• CFM... Cubic feet per minute
• Sone... An internationally recognized measurement of sound output
• HRV... Heat recovery ventilator
• ERV... Energy recovery ventilator
• ACH... Air changes an hour
• P.A. ... Pascal, a measurement in pressure
• HVI... Home Ventilation Institute
BALANCED VENTILATION - HOW DOES IT WORK

Stale air to outside

Fresh air from outside

Fresh air to the home

Stale air from the home
BALANCED VENTILATION SYSTEM CHECK LIST

✓ Size air flow properly
✓ Size and seal duct work
✓ Choose rated / labeled product
✓ Use good controls
✓ Integrate with other systems
✓ Test, measure, balance

✓ Put the V back in HVAC
Home Ventilating Institute

1. Tests and labels product
2. Verifies performance
   (air flow and sound / sone)
3. Provides listing of products
   online www.hvi.org
ES = Energy Star

If the unit is an ENERGY STAR RATED unit
• These units have better insulation, higher heat/energy recover
• Better core design
• 1.2 CFM per watts of electrical energy
• Better performance at 32 and -13 degrees
2015 MN Residential Energy Code
R403.5 Mechanical Ventilation
Mechanical ventilation

- Shall be provide with balanced ventilation that is +/- 10 percent of design capacity
- All conditioned areas... no change from previous code
- Outdoor air intakes and exhaust shall have automatic or gravity dampers that close when the ventilation system is not operating
- Kit and bath fans exempt
- 1 hour period
R403.5.5 Balanced and HRV/ERV systems

- Balanced with in 10% air flow
- HVI tested to –13 Fahrenheit or certified by engineer
- Total and continuous shall be balanced or exception
- Continuous can be balanced and low sone fan to meet intermittent
R403.5.10 DAMPERS

• Ventilation system supply and exhaust shall have accessible backflow dampers to minimize flow to the outside when system is off.

DAMPERS ARE CITED THREE TIMES IN THIS SECTION OF THE CODE

• R403.5
• R403.5.10
• R403.5.14

AT THIS TIME EQUIPMENT AND SYSTEM THAT ARE BEING INSTALLED THAT DOES NOT MEET THESE REQUIREMENTS
MN ENERGY CODE SECTION R 403, CODE VIOLATION ISSUES

Why dampering to the outside is important

IF DAMPERS ARE NOT INTERGRATED INTO THE HRV/ERV UNIT OR INSTALLED INTO THE SYSTEM AT TIME OF INSTALLATION

This guide makes reference to dampering to the outside.

The following points are the technical reasons why it is in the code three times

At this time 11-2016 there is equipment and installation that are being installed that do not meet these requirements in metro and outstate MN

This information is a culmination of 30 years of experience as a installing ventilation contractor, inspecting and servicing several different brands HRV/ERV, consulting on field reserch projects and working with the

The following information have been field verified by myself and other diagnostc professional that have national testing credentials.

Equipment operation

<table>
<thead>
<tr>
<th>Equipment operation</th>
<th>Furnace fan on and HRV/ERV off</th>
</tr>
</thead>
<tbody>
<tr>
<td>comfort</td>
<td>Higher cooling and heating costs</td>
</tr>
<tr>
<td>heat efficiency</td>
<td>moisture problems</td>
</tr>
<tr>
<td>equipment durability</td>
<td>warranty</td>
</tr>
<tr>
<td>code violation</td>
<td>code violation</td>
</tr>
<tr>
<td>wood work separation</td>
<td>natural draft equipment</td>
</tr>
<tr>
<td>flooring movement</td>
<td>backdrafting</td>
</tr>
<tr>
<td>natural draft</td>
<td>CO, smoke issues</td>
</tr>
</tbody>
</table>

| Over drying in winter, low RH% (Need to add Humidifier) | 0 |
| Air Conditioning works longer to cool and dehumidify | 0 |
| Furnace takes longer to heat house | 0 |
| Building shell pressuration ( positive pressure ) | 0 |
| Building shell depressuration ( negative pressure ) | 7 |
| Uncontrolled ventilation | 0 |
| Exhaust port becomes a intake | 0 |
| May effect core performance | 0 |
| core freeze/ubblockage | 0 |

* code violation, a exhaust port that acts like a intake could potentially bring combustion products into the home depending on operation of equipment, duct design of ventilation system and weather condition can vary the level of problem that may occur
HRV/ERV SYSTEM WITH NO DAMPERS
Return-Return Duct System
No Dampers
DAMPERING DESIGN GRAPHIC

HRV / ERV Volume Duct Design
Method One: Return / Supply

HRV / ERV Volume Duct Design
Method Two: Return / Return
R 403.5.13 Noise and vibration

- Isolation duct connection shall be used to mitigate noise transmission
VIBRATION FLEX- DUCT DETAIL
R403.5.6.1 Air distribution/circulation

- 0.075 cfm per conditioned floor area
- No less than 40 degrees at grill
R403.5.12 Filtration
R403.5.15 Labeling
R403.5.16 Documentation

- Outdoor air needs to have MERV 4 filter
- Hoods need to be marked
- Operation and maintenance instruction
VENTILATION SIZING

• Calculation example
• Table R403.5.2
• Sizing for Total TVR
• Sizing for Continuous CRV
Mechanical Ventilation Design

• Size you HRV/ERV or Balanced to meet TVR
• Size you HRV/ERV or Balanced to meet just CVR

• Exception under R403.5.5 Balanced and HRV/ERV systems
  “The balanced system and HRV/ERV system may include exhaust fans to meet the intermittent ventilation rate. Surface mounted fans shall have a maximum 1.0 sone per HVI Standard 915”
Mechanical Ventilation

- Total Ventilation Rate (cfm) = (0.02 x sq. ft. of condition space) + (15 x ( number of bedrooms + 1))
- Continuous Ventilation Rate (cfm) = is a minimum of 50% of the TVR
- TVR = Total Ventilation Rate
- CVR = Continuous Ventilation Rate

OR YOU CAN USE THE FOLLOWING TABLE
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<tr>
<th>Conditioned space(^1) (sq. ft.)</th>
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<td>210/105</td>
<td>225/113</td>
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</tbody>
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VENTILATION SIZING CALCULATION EXAMPLE

• CALCULATION
• USING THE TABLE
• SIZE OF THE HOUSE, TOTAL SQUARE FOOTAGE, BEDROOMS
  ➢ 2640 SQ. FEET
  ➢ 3 BEDROOMS
Main floor

- Living room
- Washroom #3
- Laundry room
- Kitchen
- Dining room
- Family room

1320 ft²

Second floor

- Master bedroom
- Washroom #1
- Washroom #2
- Bedroom #2
- Bedroom #1
- Bedroom #3

1320 ft²
VENTILATION CALCULATION EXAMPLE

• Total Ventilation Rate (cfm) = (0.02 x sq. ft. of condition space) + (15 x (number of bedrooms + 1))
  ➢ TVR= (.02 x 2640 SQ FT) + (15 x (3 + 1))
  ➢ TVR= 58.2 + 60 = 112.8 CFM

• Continuous Ventilation Rate (cfm) = Total ventilation rate (50 %)
  ➢ CVR= 112.8 x .5 = 56.4 CFM

FROM TABLE R403.5.2
TVR= 120
CVR=60
# TABLE R403.5.2  
**Total & Continuous Rates (in CFM)**

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<th>3</th>
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<td>225/113</td>
</tr>
</tbody>
</table>
SIZING OPTION ONE

• Size your HRV/ERV or Balanced to meet TVR
• Both Continuous and Intermittent must be balanced
SIZING OPTION TWO

• Size you HRV/ERV or Balanced to meet just CVR
• Install a surface mounted fan that is rated at 1.0 sone or less, this is your intermittent ventilation
• If this method is used, air flow needs to be verified on HRV/ERV and exhaust fan that is designed for the intermittent ventilation
EQUIPMENT SELECTION

• For sizing option one
  ➢ You would select and install an HRV/ERV that would meet both TVR and CVR
  ➢ Most product on the market would meet CVR on low speed and TVR on high speed
  ➢ This means that the HRV/ERV would be a larger, higher CFM model

• For sizing option two
  ➢ You would select and install an HRV/ERV that would meet just CVR
  ➢ You would select and install an low 1 sone surface mounted fan (bath fan)
  ➢ The combination of these two device would need to meet TVR
  ➢ This means that the HRV/ERV would be smaller, lower CFM model
Smaller HRV/ERV
BALANCED - HRV/ERV

- One hood instead of two

INTAKE

EXHAUST
DUCT DESIGN HRV/ERV

- Source point
- General ventilation
- Return- return
- Return- supply
- Fully ducted
**Installation Options**

**General Ventilation**
- Air is exhausted from the basement (musty smells, moisture) and the kitchen area (moisture, cooking odors, gas stove by-products).
- Tempered fresh air is ducted to furnace return or supply.

**Source Point Ventilation**
- Air is exhausted from the kitchen area and can replace bathroom fans in applications where duct lengths are not excessive.
- Tempered air is ducted to furnace return or supply.

**Volume Ventilation**
- The existing furnace ductwork is used to exhaust and supply fresh air to the building.
- Tempered air is ducted to furnace return or supply.
- Furnace fan needs to run on a return/return or return strategy.
RETURN – SUPPLY DUCT DESIGN

- Great for existing houses
- Air handler doesn’t need to run full time
- Simple, quick installation
- Cost effective in new houses
- Most common installation
RETURN-RETURN DUCT DESIGN

- Great for existing houses
- Air handler runs to optimize filtration & fresh air distribution – great for allergy sufferers
- Simple, quick installation
- Cost effective in new houses
GENERAL DUCT DESIGN

- One exhaust point per floor
- Air handler doesn’t need to run full time
- Combination of bath fans & HRV/ERV
- Cost effective in new houses
FULLY DUCTED

- For non-forced air heating systems
- Exhaust from bathrooms & kitchen
- Supply to bedrooms & main living areas
- Optimum air quality control
SOURCE POINT DESIGN AND BATH FANS

• DEPENDING ON DUCT LENGTH, TYPE AND SIZE OF THE BATH ROOM, ONE MAY USE HRV/ERV AS BATHROOM EXHAUST SYSTEM... 5 TO 6 ACH. NO BATH FAN NEEDED

• ZONING OF HRV/ERV IS AN OPTION

• AN EXHAUST POINT FROM HRV/ERV AND BATH FAN IN THE SAME BATHROOM IS AN OPTION
DESIGN DETAILS

• THERE IS A LOT OF EXPERIENCE AND HISTORY ON HOW SYSTEM ARE INSTALLED ....LOWEST COST IS NOT ALWAYS THE BEST OPTION , THE INDUSTRY IS 30 PLUS YEARS OLD, REVIEW THESE DESIGNS WITH SOME ONE THAT HAS DIRECT EXPERIENCE WITH ALL THESE VENTILATION DESIGNS, SIT DOWN WITH AN HVAC PROFESSIONAL AND REVIEW YOUR OPTION FOR THE HOMES THAT YOU ARE BUILDING
BALANCING R403.5.6.1.3  Airflow Verification

• Greater then 30 cfm
• Consequence if you don’t balance your system
• Building pressure
• Method of testing air flow
WHAT IF SYSTEM IS NOT BALANCED?

• Comfort complaints, call backs
• Core freeze up and blockage
• Waste of energy
• House can get to dry in winter, to humid in summer
• Building pressure issues
NEGATIVE PRESSURE

- Cold air infiltrates house.
- Increase of energy cost
- Negative pressure may cause combustion exhaust drawbacks.
POSITIVE PRESSURE

Hot and/or humid air infiltrate walls and condensate on insulation.

Heat loss.

Do not pressurize a house in a cold climate.
EQUAL PRESSURE

Balanced

Supply airflow is equal (C.F.M.) to exhaust
Balancing is required to all units
AIR FLOW VERIFICATION

Balancing air flows required by code
Balancing dampers
FLOW STATIONS WITH MAGNEHELIC GAUGE
TESTING CFM ON BATH FAN, FLOW HOOD
DIFFERENCE BETWEEN HRV AND ERV

- HRV are by far most common type installed units
- HRV is best to reduce window condensation
- ERV will retain more humidity in home in the winter
- ERV will bring in less humidity in summer
- Climate, cost and application is the driving factor on what type is selected
<table>
<thead>
<tr>
<th></th>
<th>Climate</th>
<th>Moisture Issues</th>
<th>AC</th>
<th>Allergies/Respiratory Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRV</td>
<td>cold</td>
<td>Window condensation</td>
<td>Minimal AC load</td>
<td>Good choice</td>
</tr>
<tr>
<td>ERV</td>
<td>warm</td>
<td>Overly dry in winter, humid in summer</td>
<td>High AC load</td>
<td>Best choice</td>
</tr>
</tbody>
</table>
H.R.V. = Heat Recovery Ventilator

- Recovers heat or temperature (sensible)
- Cross-flow core
- Controls excess moisture in winter
E.R.V. = Energy Recovery Ventilation

- Recovers humidity (latent) and heat (sensible)
- Year round energy efficiency for new & existing homes
HUMIDITY IN WINTER

Understand what is the relationship between the ventilation strategy and how to humidify the home in the cold weather months
Condensation

• LIFESTYLE?
• VENTILATION?
• HUMIDIFIER OPERATION?
• TEMP. OUTSIDE AND INSIDE?
• RH% RELATIVE HUMIDITY?
Humidity gauge a must!
BYPASS STYLE WITH AUTO CONTROL
TrueSTEAM
As Easy as 1-2-3-4

1. Mount
2. Hang
3. Plumb
4. Wire

See inside for detailed instruction and remote mounting options!
New Control Systems

• Temperature Compensating Humidity Controls - Automatically adjust humidity set point based on changing outdoor conditions
  • Ideal humidity level in the winter is as high as you can keep it without causing moisture on the windows
  • With manual humidistats, the humidity is always too high, causing moisture damage, or too low, causing discomfort
Dust (particles) and Gases
CONTROLS
Integrated control and quick wiring connect
SIMPLE PUSH BUTTON WITH SOME GRAPHICS
T-stat and Ventilation control
ADVANCED CONTROLS
Bath room switch, high speed override
NEW VENTILATION CONTROLS, can be confusing
MAINTENANCE

• General guide lines

Every 2-3 months
- Check and clean filters

Once per year
- Clean HRV/ERV cores
- Clean intake vents, grilles, hoods
- Check operation of dampers / controls
FILTERS
Air intake needs to be cleaned
TO CLOSE TO GRADE

Shelter Supply
Explain to the homeowner… how it works and maintenance
Thank you for your time

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• Dakota Supply Group
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