

# Ventilation and Moisture Control: Equipment and Controls

2002 National Workshop on State Energy  
Codes

Des Moines, Iowa

July 17, 2002

# Don Stevens

- US Trainer, Heating, Refrigeration, and Air Conditioning Institute of Canada (HRAI)
- Principal, Stevens and Associates
- Chairman, Home Ventilating Institute
- Voting Member, ASHRAE 62.2 Committee
- Chairman, Systems Subcommittee of 62.2

# VENTILATION TRAINING

- **HRAI has been offering training since the mid '80s**
- **Training has been delivered to over 500 participants in 9 states:**
  - **Alaska, Georgia, Maine, Massachusetts, Minnesota, New York, New Hampshire, Oregon, and Wisconsin**
- **Total of 5,500 currently certified in ventilation in US and Canada**
- **Training offered in partnership with State Energy Offices, Manufacturers, and utilities**
- **HRAI was contracted by the State of Minnesota with SEP funds to develop and deliver training on the new State Energy Code to over 1,100 people**
- **For more information, contact Joanne Spurrell, Director, Education and Market Development. Tel: 1-800-267-2231 e-mail: [ispurrell@hrai.ca](mailto:ispurrell@hrai.ca)**







345

# Codes and Standards

- Washington State Ventilation and Indoor Air Quality Code (1991, updated 2000)
  - 1.5 sone max fans or integrated systems operating for a minimum of eight hours a day
    - 15 cfm/person plus .01 cfm/square foot; generally 50-125 cfm
  - 50 cfm intermittent/20 cfm continuous bath fan
  - 100 cfm intermittent/25 cfm continuous kitchen exhaust

# VIAQ Whole House Rates

Floor Area, ft2	Bedrooms								
	0	1	2	3	4	5	6	7	8
<500	35	35	50	65	80	95	110	125	140
501-1000	40	40	55	70	85	100	115	130	145
1001-1500	45	45	60	75	90	105	120	135	150
1501-2000	50	50	65	80	95	110	125	140	155
2001-2500	55	55	70	85	100	115	130	145	160
2501-3000	60	60	75	90	105	120	135	150	165
3001-3500	65	65	80	95	110	125	140	155	170
3501-4000	70	70	85	100	115	130	145	160	175
4001-5000	80	80	95	110	125	140	155	170	185
5001-6000	90	90	105	120	135	150	165	180	195
6001-7000	100	100	115	130	145	160	175	190	205
7001-8000	110	110	125	140	155	170	185	200	215
8001-9000	120	120	135	150	165	180	195	210	225
>9000	130	130	145	160	175	190	205	220	235

# Codes and Standards (cont.)

- International Building Code (IBC) (2000)
  - 50 cfm intermittent/25 cfm continuous bath fan
  - Vented range hood not required if operable window
- International Residential Code (IRC)
  - 50 cfm intermittent/25 cfm continuous bath fan or operable window
  - Vented range hood not required if operable window

# Codes and Standards (cont.)

- ASHRAE Standard 62.2 (June 2002 draft)
  - 1.0 some max fans or integrated systems operating continuously in most climates
  - 3.0 some max range hoods at 100 cfm/low speed and bath fans at 50 cfm (pending)
  - Backdrafting test required if two largest fans exceed 15 cfm/100 square feet
  - Mechanical whole house IAQ ventilation required in most climates
  - Fourth Public Review this fall

# ASHRAE 62.2P Required Ventilation Rate

Floor Area (square feet)	Bedrooms				
	0-1	2-3	4-5	6-7	>7
<1500	30	45	60	75	90
1501-3000	45	60	75	90	105
3001-4500	60	75	90	105	120
4501-6000	75	90	105	120	135
6001-7500	90	105	120	135	150
>7500	105	120	135	150	165

# Ventilation Strategies

- Supply Ventilation
- Exhaust Ventilation
- “Balanced” Ventilation
- Other Equipment

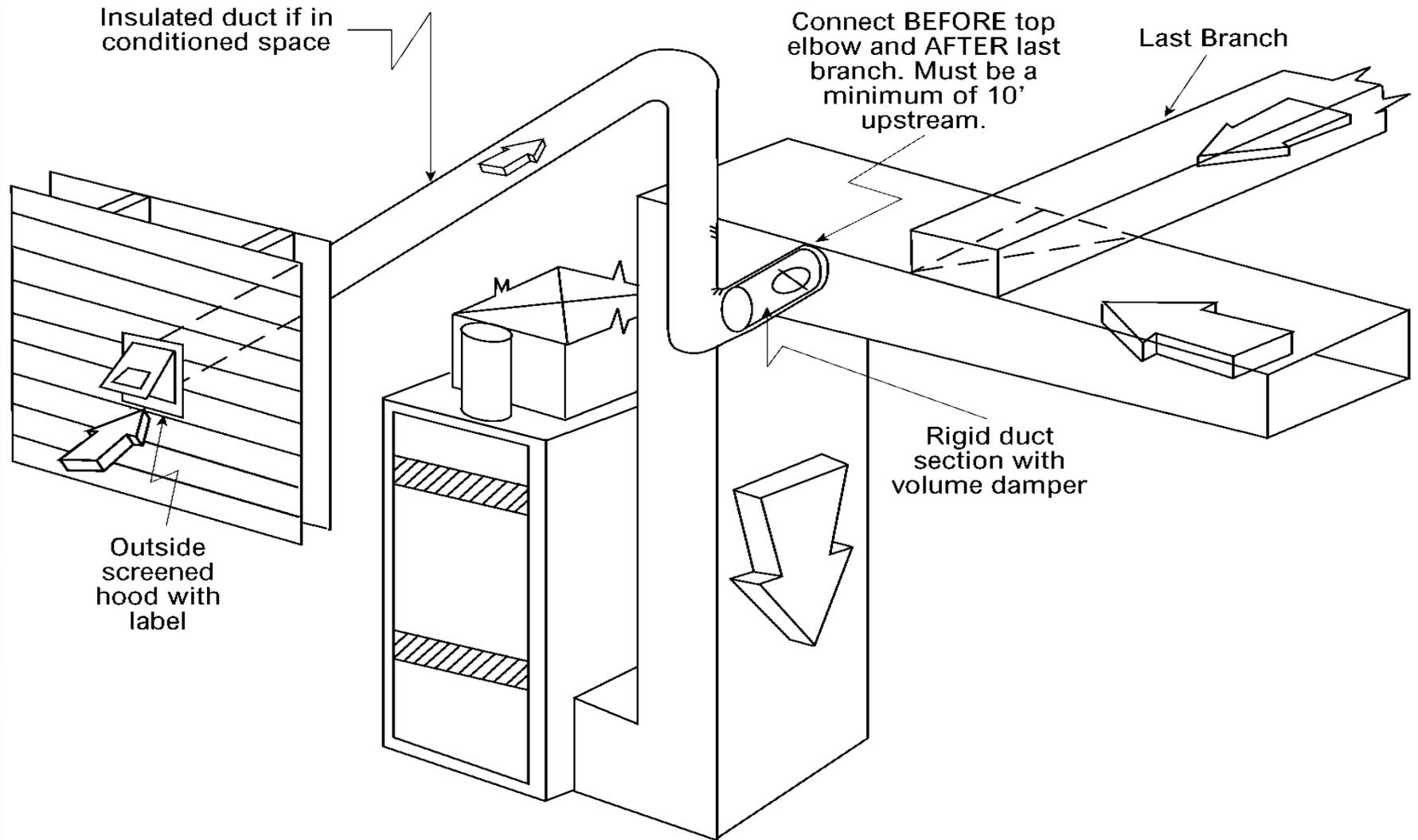
# Supply Ventilation Options

- Integrated with Air Handler
- Inline Supply Fan
- Multiport Supply Fan
- Dehumidifying Supply Fan

# Integrated with Air Handler

- Use air handler to pull in outdoor air
- Advantages:
  - distribution
  - filtration
- Disadvantages:
  - Fan energy
  - Cold air on furnace heat exchanger
  - Draft complaints

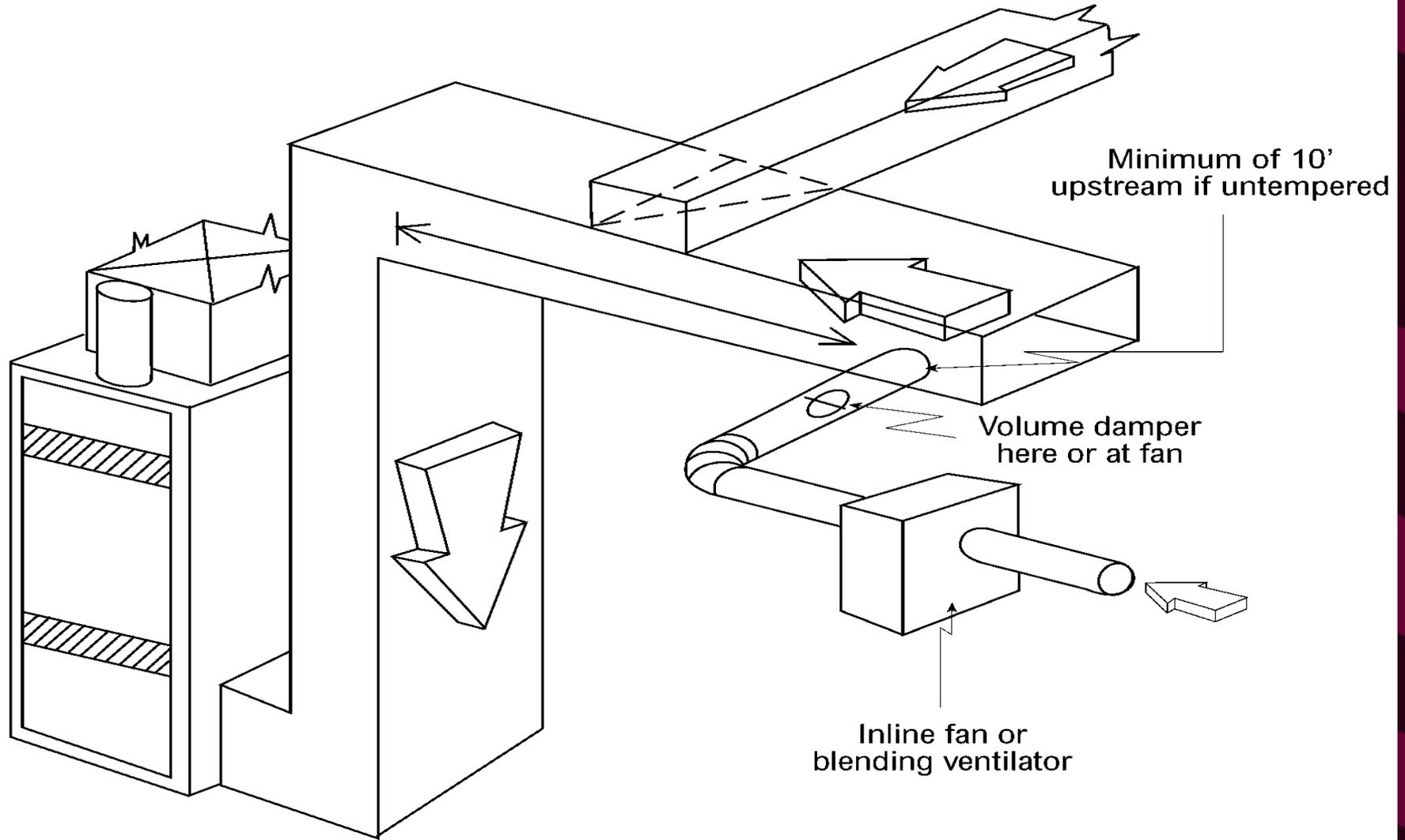
# OUTDOOR AIR DUCT INTEGRATED WITH THE FURNACE



# Inline Supply Fan

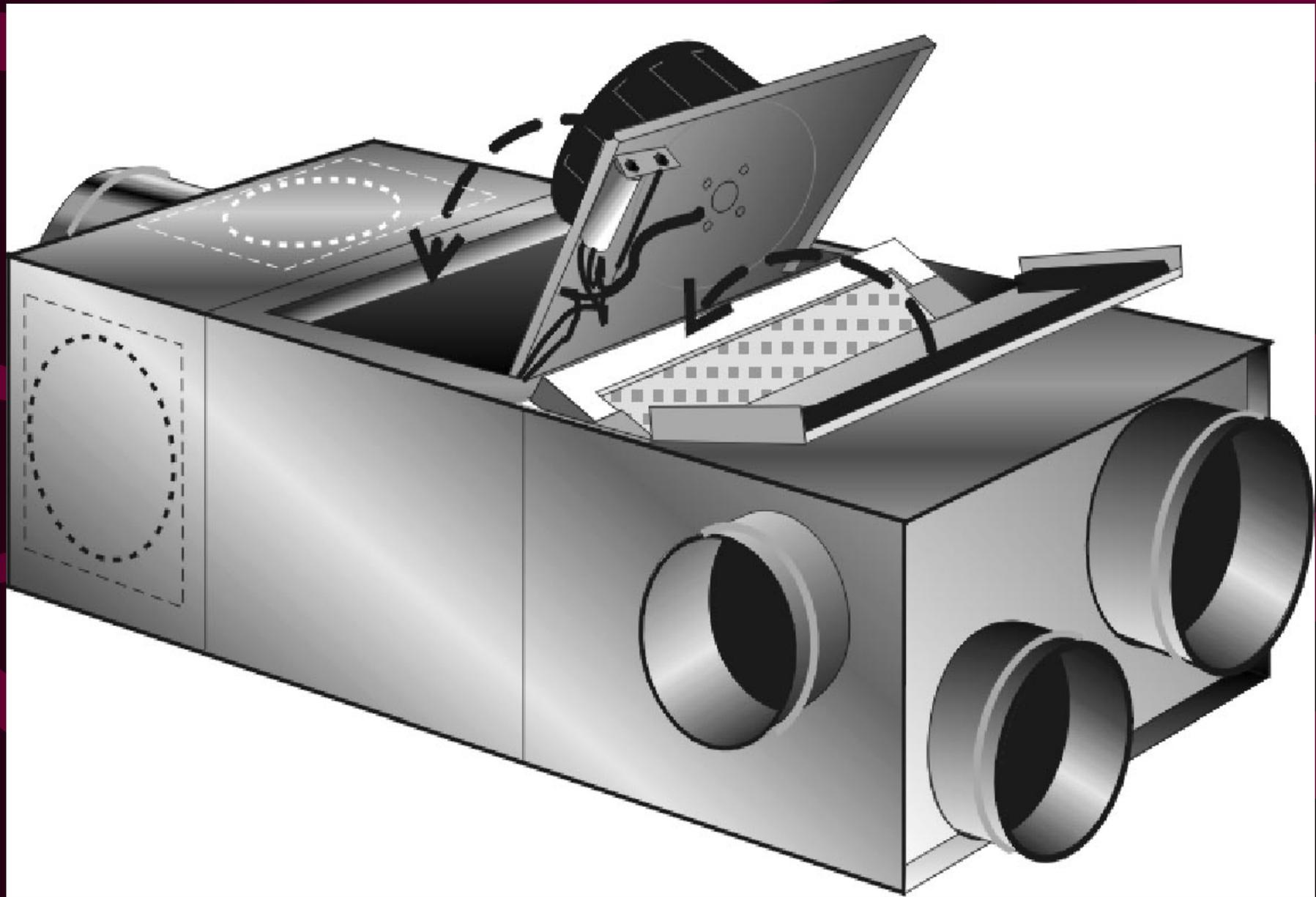
- May be integrated with the furnace for distribution
- May have dedicated supply duct(s)
- Advantages:
  - Quiet, low energy
- Disadvantages:
  - Extra fan
  - Must be accessible

# POWERED MAKE-UP AIR CONNECTION



# Multiport Supply Fan

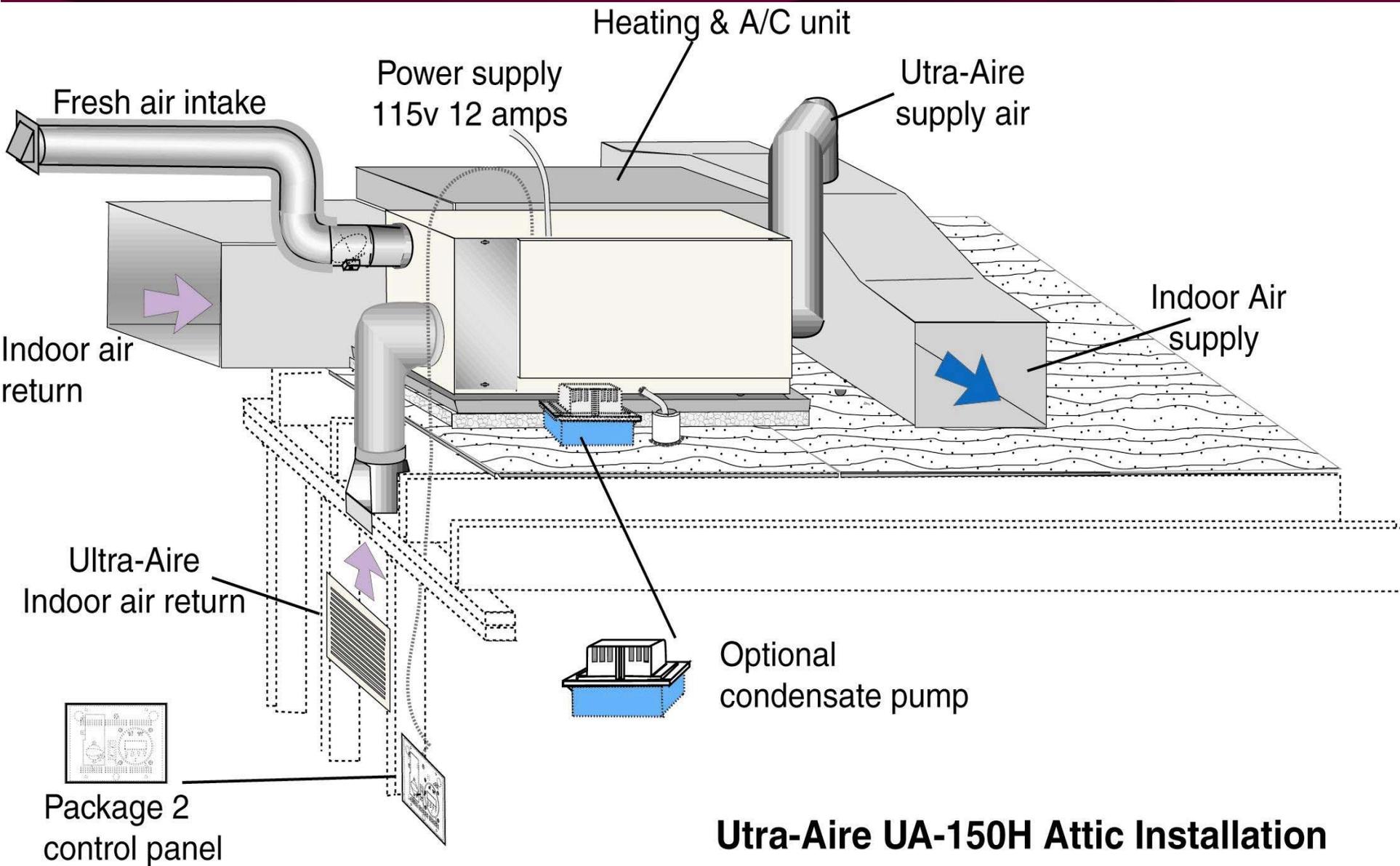
- Delivers to several rooms
- Can blend and/or filter air for comfort
- Advantages:
  - Quiet, filtration, tempering, multiple grilles
  - Avoids air handler temperature shock issues
- Disadvantages:
  - More ducting
  - Must be accessible for service





# Dehumidifying Supply Fan

- Single unit provides dehumidification, filtration, and ventilation air
- Advantages:
  - Multipurpose unit
  - Dehumidifies and filters both indoor and outdoor supply air
- Disadvantages:
  - First cost, ducting



**Ultra-Aire UA-150H Attic Installation**

# Exhaust Ventilation Options

- “Double Duty” Bath Fan
- Remote Inline Exhaust Fan
- Multiport Exhaust Fan
- Quiet Range Hoods
- Remote Inline Range Hood Exhaust Fan

# “Double Duty” Bath Fan

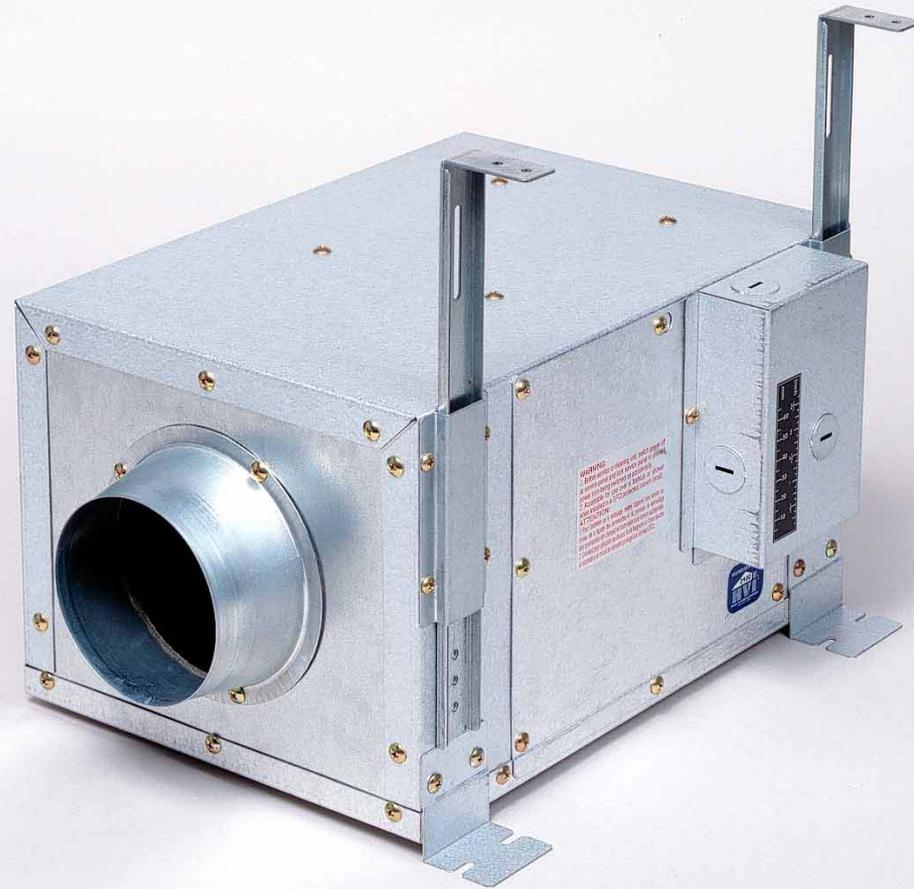
- Quiet bath fan that provides both spot ventilation and whole house IAQ ventilation
- 0.2-1.5 sone fan to increase operation and life
- Advantages:
  - Quiet, long life
  - no additional fan
- Disadvantages:
  - First cost



# Remote Inline Exhaust Fan

- Inline fan in attic with one or two pickups
- Remote mounted so fan noise is not an issue
- Advantages:
  - Quiet operation if flex duct is used
  - Versatile installation; may replace two fans
- Disadvantages:
  - First cost, may be noisy if metal duct is used
  - Must be accessible for service



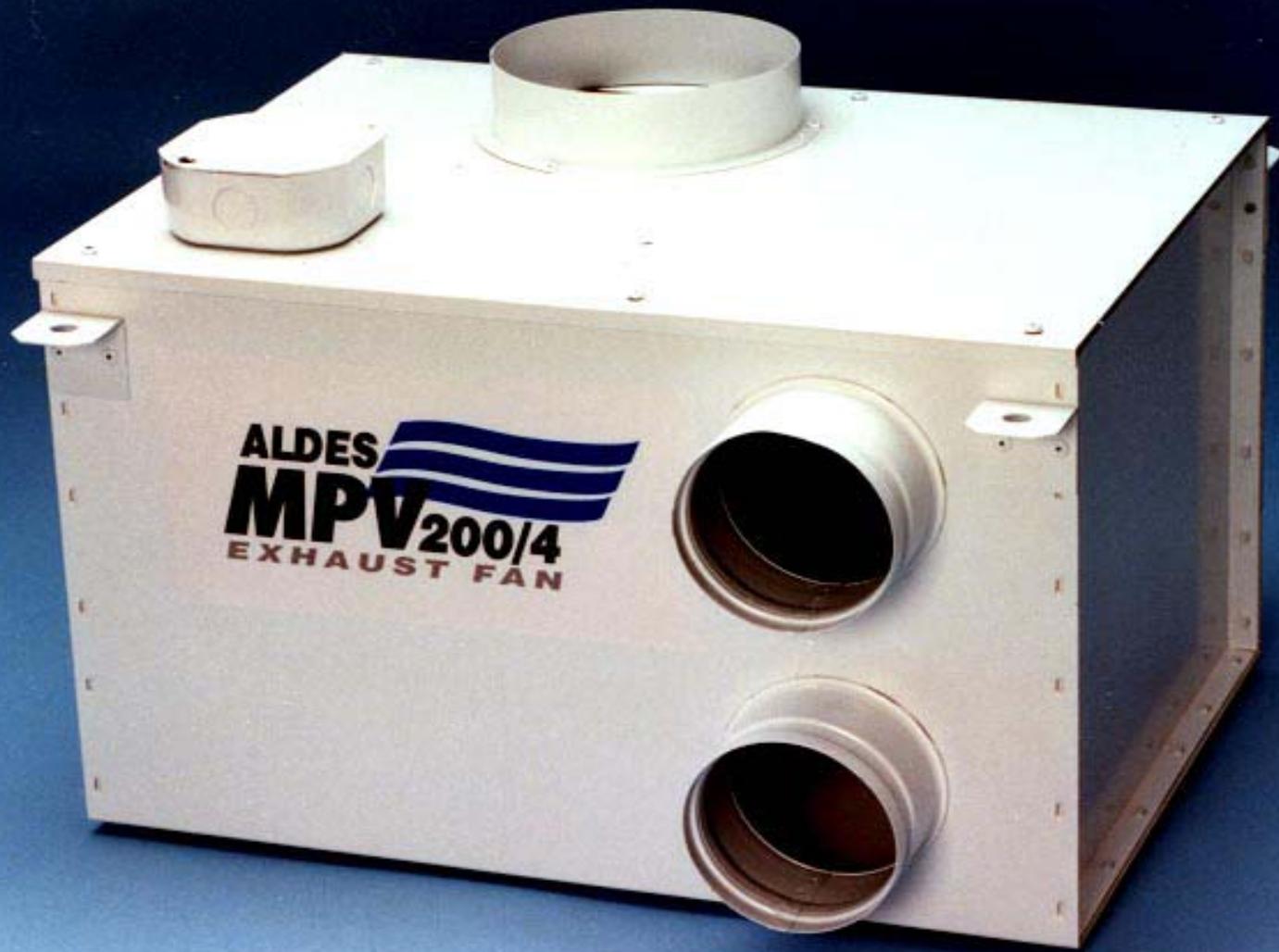


WARNING:  
Do not touch the metal parts of the enclosure when the unit is energized.  
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Do not touch the metal parts of the enclosure when the unit is energized.



# Multiport Exhaust Fan

- Box fan in attic with 3-8 pickups
- Remote mounted so fan noise is not an issue
- Advantages:
  - Quiet operation if flex duct is used
  - Versatile installation; may replace 3-8 fans
- Disadvantages:
  - First cost, may be noisy if metal duct is used
  - Must be accessible for service



**ALDES**  
**MPV200/4**  
EXHAUST FAN

# Quiet Range Hoods

- ASHRAE Standard 62.2 calls for quiet range hood fans
- 1.5 to 3.0 sones at low speed/100 cfm nominal
- Advantages:
  - Quiet operation at low speed (0.3-3.0 sone)
  - Several models available
- Disadvantages:
  - First cost

## HVI 2100 CERTIFIED PRODUCTS

## Section 1-4

MODEL OR SERIES	HVI CERTIFIED CFM	SONES	MODEL OR SERIES	HVI CERTIFIED CFM	SONES	MODEL OR SERIES	HVI CERTIFIED CFM	SONES	
<b>BROAN - NUTONE LLC</b>									
Nutone									
<b>Bathroom - Exhaust Fans</b>									
605RP	70	4.0	HD80LNT	80	2.5	<b>Range Hoods</b>			
665RF	70	4.0	QT80	80	2.0				
665RP	70	4.0	QT90	90	2.0	SL6200			
665RSP	70	4.0	QT100L	100	3.5	3 x10 Ver.	190	7.0	
667RN	50	3.0	QT100FL	100	3.5	3 x10 Hor.	160	7.0	
668RP	70	4.0	QT100LH	100	3.5	7" Rd	220	8.0	
671R	90	3.0	QT100LM	100	3.5	RL6100			
672R	110	4.0	QT100LHM	100	3.5	3x10 Ver.	160	6.5	
686	80	6.0	QT110	110	3.0	3x10 Hor.	160	6.5	
696	70	6.0	QT110H	110	3.0	RL6100F			
696N	50	4.0	QT130 Ver.	120	0.9	3x10 Ver.	160	6.5	
741BRNT	70	3.5	Hor.	130	1.0	3x10 Hor.	160	6.5	
741BRFLNT	70	3.5	QT-140L Ver.	150	2.5	7" RD	190	6.5	
741SNNT	70	3.5	Hor.	150	2.0	RL6300	190	6.0	
741WHNT	70	3.5	QT-150 Ver.	160	2.5	SM6500	190	7.0	
741WHFLNT	70	3.5	Hor.	160	2.5	Hor.	190	8.0	
763RLN	50	2.5	QT9093CH	110	3.0	7" RD	220	7.0	
769RL	70	3.0	QT9093BR	110	3.0	WA6500	200	4.5	
769RF	70	3.0	QT9093WH	110	3.0	Hor.	170	4.5	
770F	70	3.0	<b>Inline Fans</b>			7" RD	220	4.5	
2676FNT/110RDB	110	4.0	ILF120 @ 0.20"SP	110		WS1	Hor HS+	200	4.0
2684FNT/80RDB	80	2.5	ILF130 @ 0.20"SP	130		Hor LS+	110	1.5	
8663RF	100	3.5	ILF250 @ 0.20"SP	250		Ver HS+	190	4.0	
8663RP	100	3.5	ILF360 @ 0.20"SP	360		Ver LS+	110	1.5	
8663RLG	100	3.5	ILF530 @ 0.20"SP	530		7" RD HS+	210	4.0	
8663RMSA	100	3.5	<b>Exterior Mounted Ventilators</b>			7" RD LS+	120	1.5	
8663RMBR	100	3.5	RF-40 @ 0.03"SP	1030		WS2	Hor HS+	250	3.5
8663RMAB	100	3.5	@ 0.10"SP	1000		Hor LS+	100	0.9	
8664RP	100	3.5	RF-1N @ 0.03"SP	660		Ver HS+	240	4.5	
8673RP	100	3.5	@ 0.10"SP	620		Ver LS+	110	1.0	
8814R	110	4.0	WF-1N @ 0.03"SP	690		7" RD Ver HS+	230	4.0	
8832WH	80	2.5	@ 0.10"SP	650		7" RD LS+	110	0.8	
8832SA	80	2.5	<b>Kitchen - Exhaust Fans</b>			WS3	Hor BS+	400	7.0
8833	80	3.0	8010SA	250	4.0	Hor HS+	250	3.5	
8870	80	6.0	8010WH	250	4.0	Hor LS+	100	0.4	
9093	70	3.5	8070SA	160	4.5	Ver BS+	350	7.5	
						Ver HS+	230	3.5	
						Ver LS+	110	0.3	
						7" RD BS+	340	8.0	
						7" RD HS+	220	4.0	
						7" RD LS+	100	0.5	

# Remote Inline Range Hood Fan

- Can be very quiet
- Moves fan out of room and out of your face
- Advantages:
  - Quiet
  - Variable Speed
- Disadvantages:
  - First Cost
  - Must use sound-reducing muffler



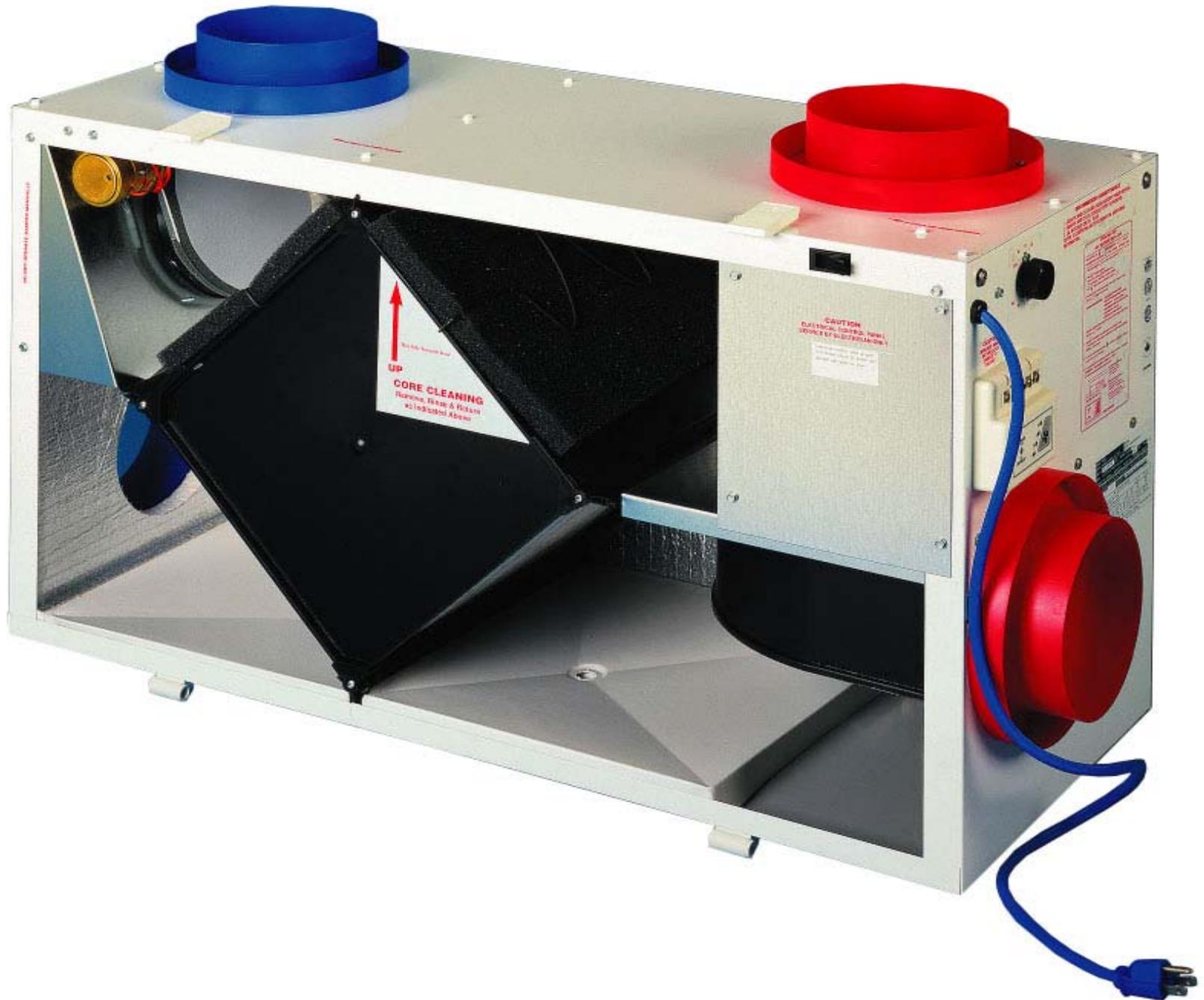


# “Balanced” Ventilation Options

- Heat Recovery Ventilator
- Energy Recovery Ventilator
- Balanced Supply and Exhaust Fans
- Integrated Heating/Cooling/Ventilation

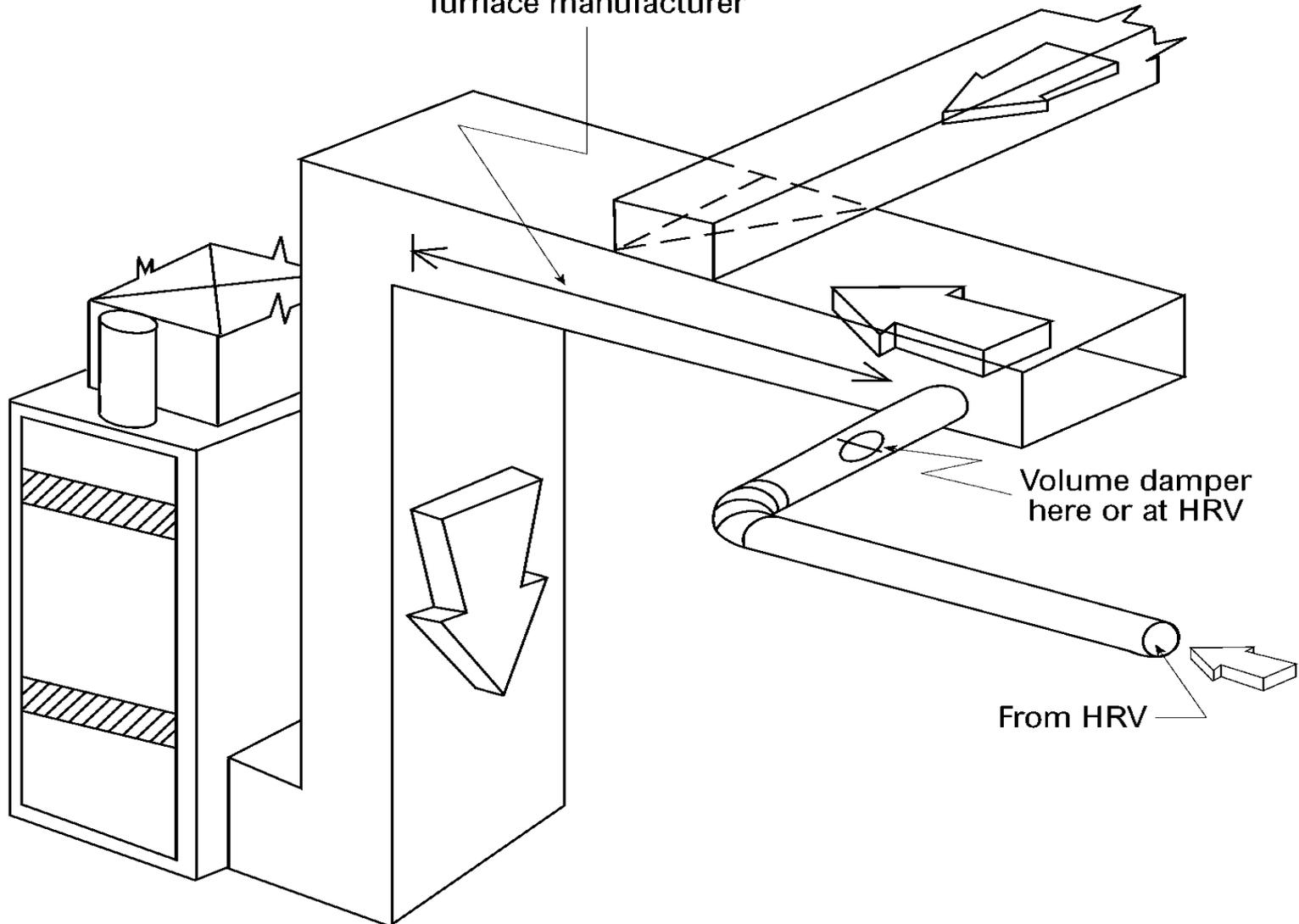
# Heat Recovery Ventilator

- Primarily used in cold climates
- Typically 60-70% efficient at heat recovery
- Advantages:
  - May reduce heating costs
  - Reduces drafts
- Disadvantages:
  - Highest first cost
  - “Cost effectiveness” is hard to calculate

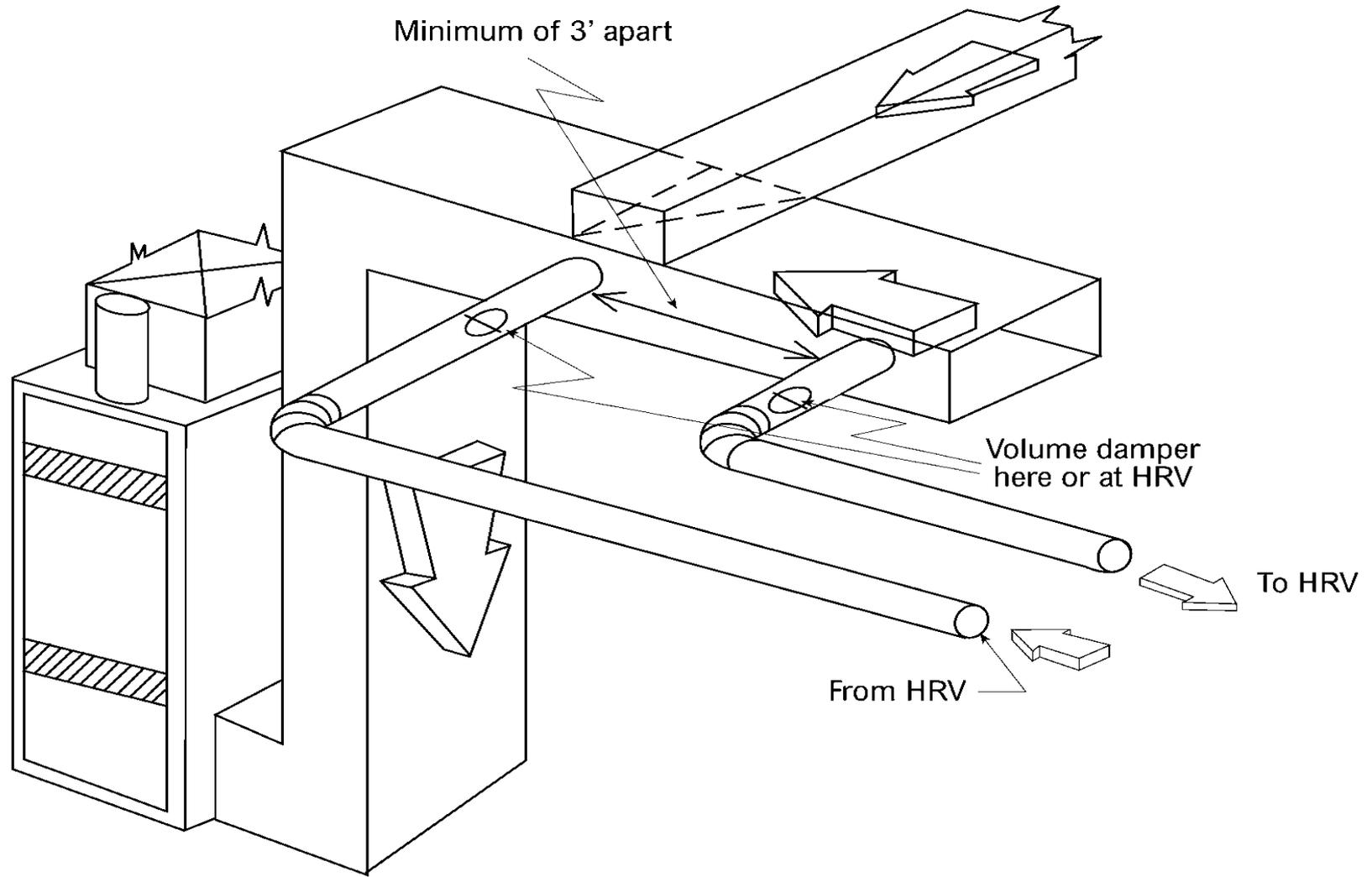


# DIRECT HRV CONNECTION WITH SUPPLY ONLY

Verify correct distance with  
furnace manufacturer

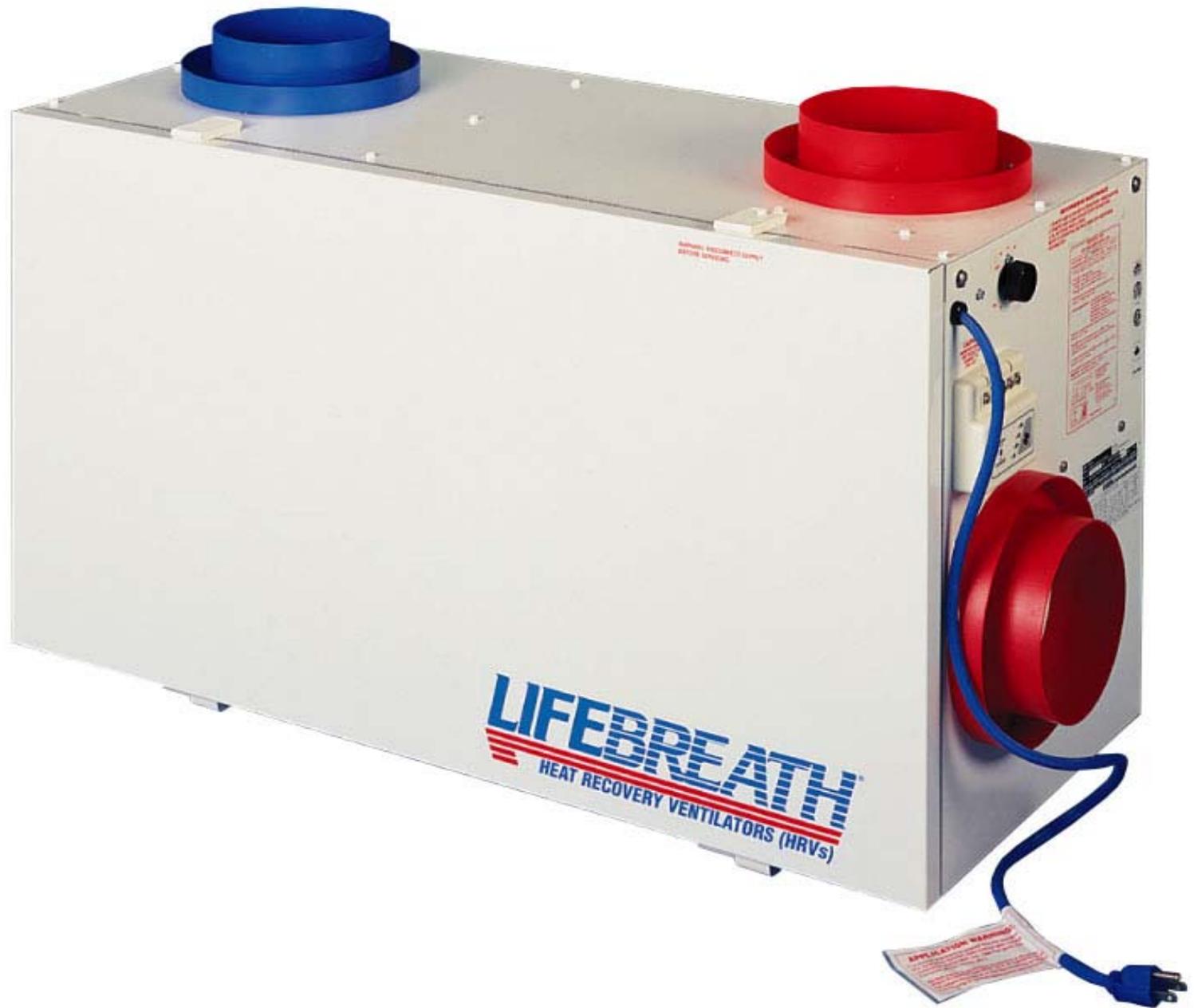


# DIRECT HRV CONNECTION WITH BOTH SUPPLY AND RETURN



# Energy Recovery Ventilator

- Primarily used in cooling climates
- Typically 70-80% efficient at energy recovery
- Advantages:
  - May reduce cooling costs, reduces drafts
- Disadvantages:
  - Highest first cost
  - “Cost effectiveness” is hard to calculate

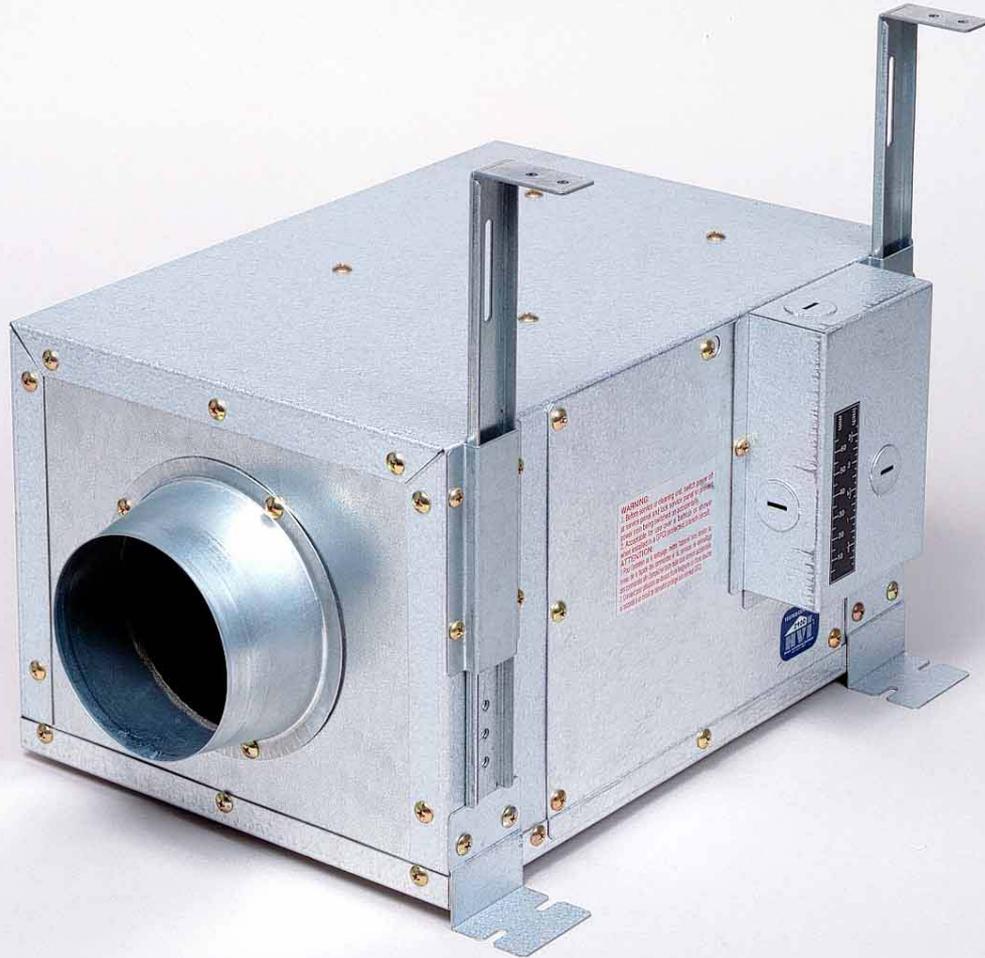


**LIFEBREATH**  
HEAT RECOVERY VENTILATORS (HRVs)

APPLICATION WARNING

# Balanced Supply and Exhaust Fans

- Uses a quiet exhaust fan and a supply fan
- Fan flows nominally equal to maintain balanced flow
- No heat exchange core
- Advantages:
  - Lower cost way to get balanced flow
- Disadvantages:
  - Higher first cost for two fans



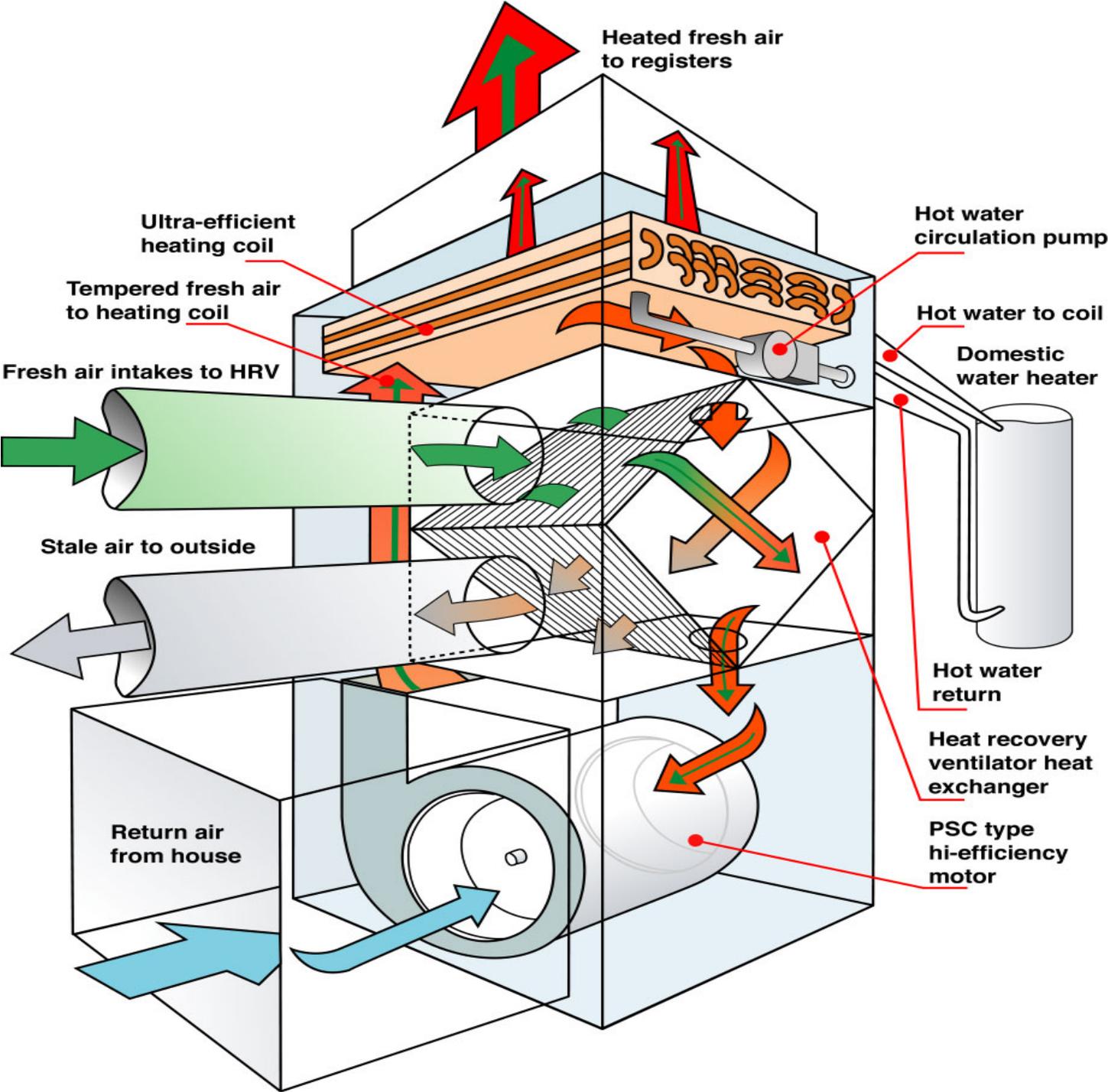
**WARNING**  
Before working on this enclosure, disconnect the power source and lock out the power source. Do not touch the internal components until the power source is locked out and the enclosure is cooled to normal temperature.  
**ATTENTION**  
Do not touch the internal components until the power source is locked out and the enclosure is cooled to normal temperature. Do not touch the internal components until the power source is locked out and the enclosure is cooled to normal temperature.





# Integrated Heating/Cooling/Ventilation

- One unit provides all HVAC needs
- Canadian Advanced Integrated Mechanical System (AIMS) Project
- Advantages:
  - Single unit, simpler ducting
- Disadvantages:
  - First cost, lack of awareness and training



# Typical Integrated System

# Other New Ventilation Equipment

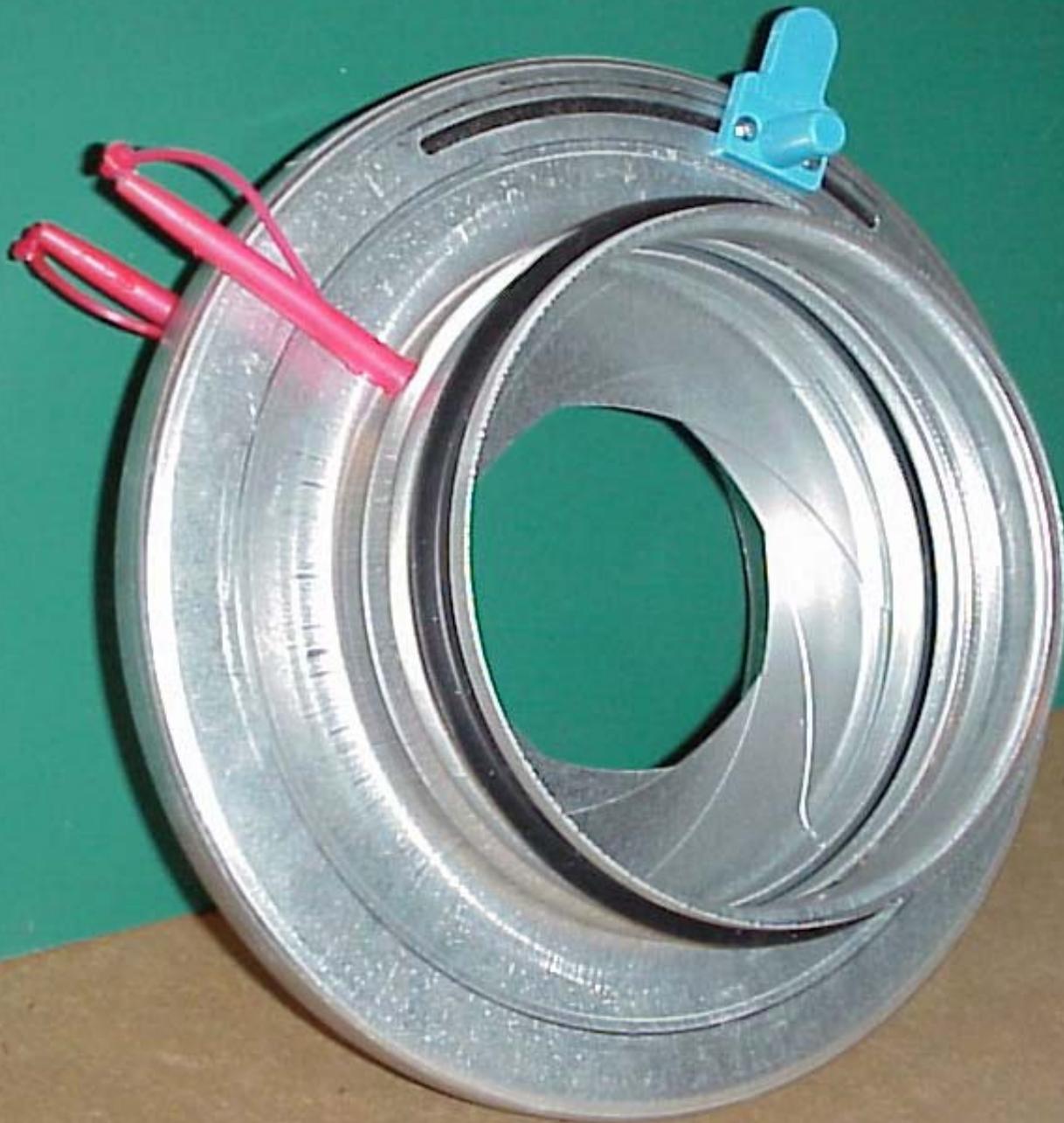
- Through-the-wall inlets
- Fan-Heat-Light options
- Multi-speed fans
- Balancing tools
- Ceiling Radiant Dampers for fans
- Through-the-wall fans



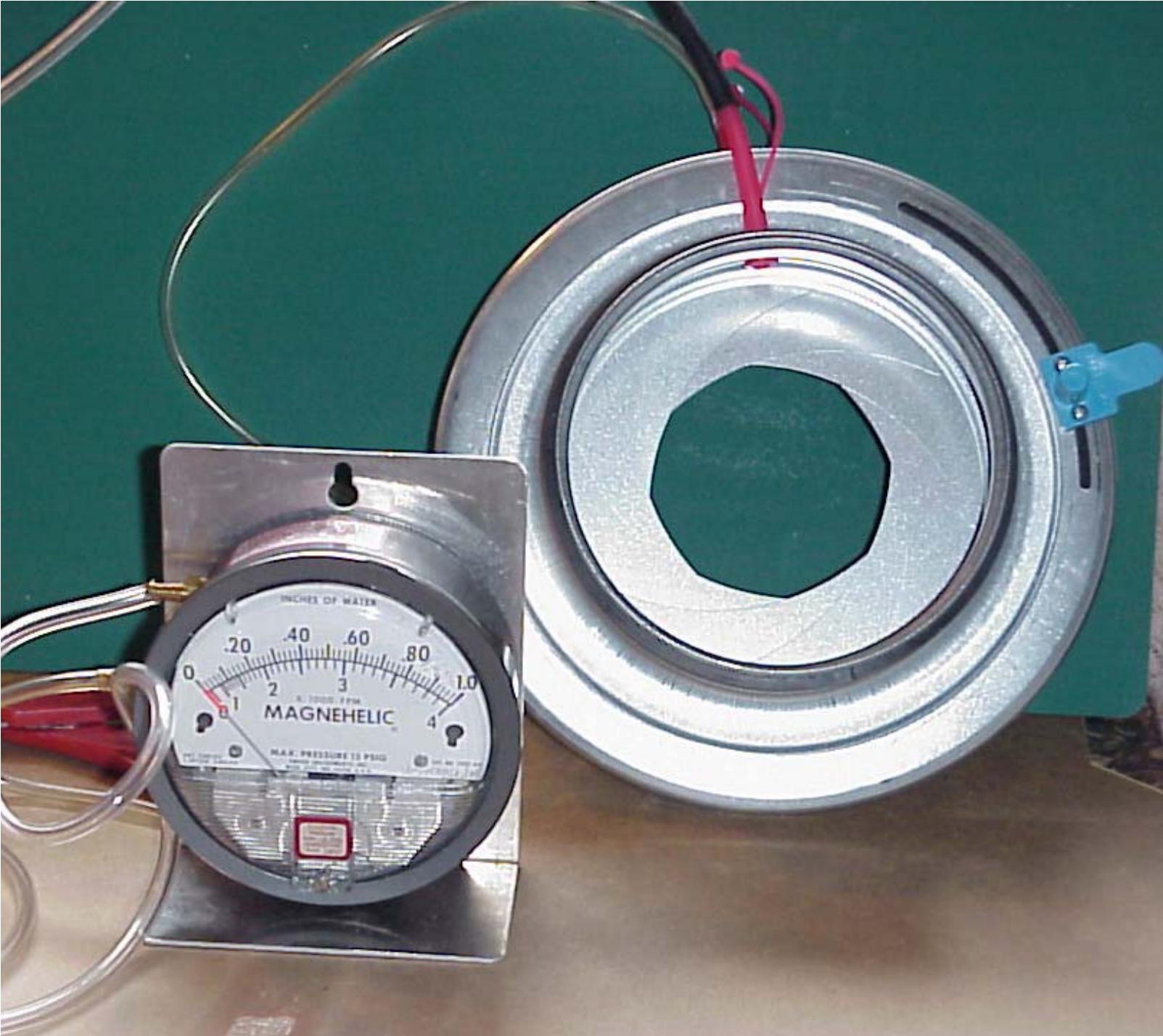
Through-  
the-wall  
inlet



Quiet  
fan-  
light-  
heater



Adjustable  
Iris  
balancing  
damper  
with  
pressure  
taps

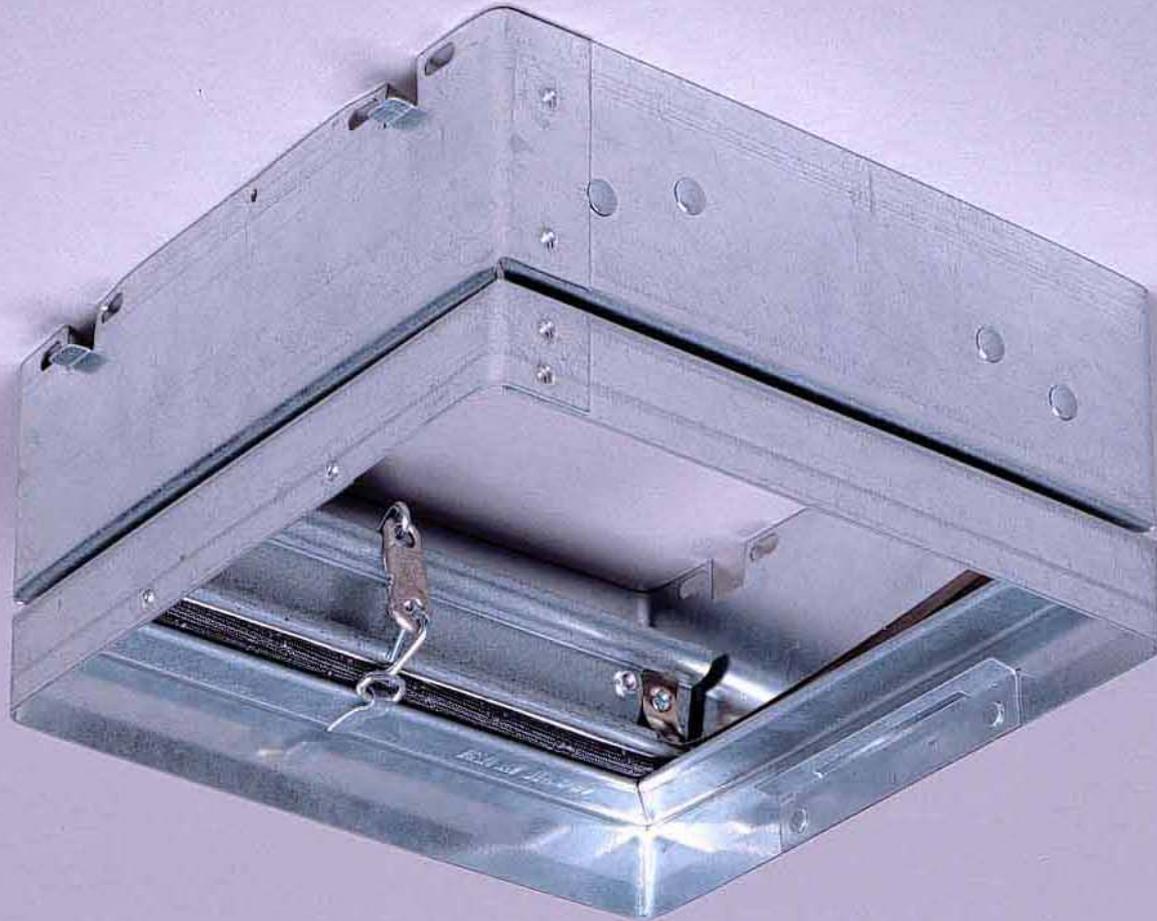


Setting  
the  
flow  
with a  
gauge



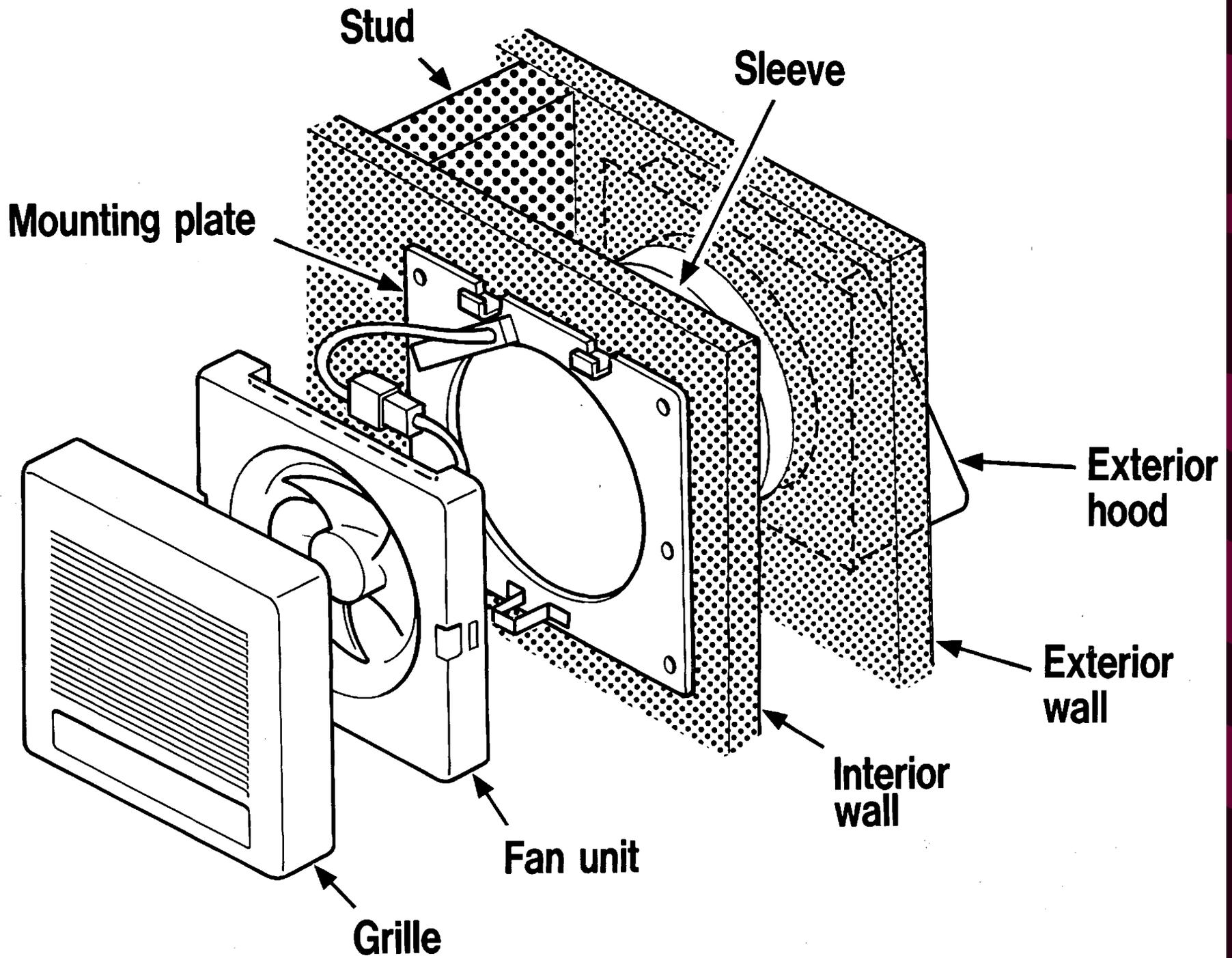
Setting the  
flow with a  
digital  
micro-  
manometer

# Ceiling Radiant Fire Damper



# Through-the-wall fan





# Ventilation Equipment Selection

- Performance Testing and Certification
- Energy Star Ventilation Equipment
- Utility Promotion
- Codes and Standards

# Performance Testing and Certification

- Home Ventilating Institute
  - Ventilation Industry Trade Association
  - 85%+ of North American products
  - Airflow and sound testing
  - Certification program
  - Certified Product Directory
  - [www.hvi.org](http://www.hvi.org)
  - 1-847-394-0150

# Testing and Certification at HVI

- Testing done at the Air Movement and Control Association International (AMCA) Laboratory in Arlington Heights, Illinois
- AMCA Lab can test ventilation products with airflow from 0 to 40,000 cfm and sound from less than 0.3 sones to over 25 sones

# Testing and Certification (cont.)

- Fans are mounted on a stand for airflow testing
- A calibrated airflow test chamber is used



# Testing and Certification (cont.)

- Fan airflow is monitored automatically by AMCA lab technician
- Measurements taken at a variety of pressures from 0 “w.g. to shutoff of fan at 0.4-0.8”w.g.



Test Number: 19522-A1  
Date of Test: 02/14/02  
Tested For: Panasonic  
P<sub>2</sub>: 29.39 in Hg

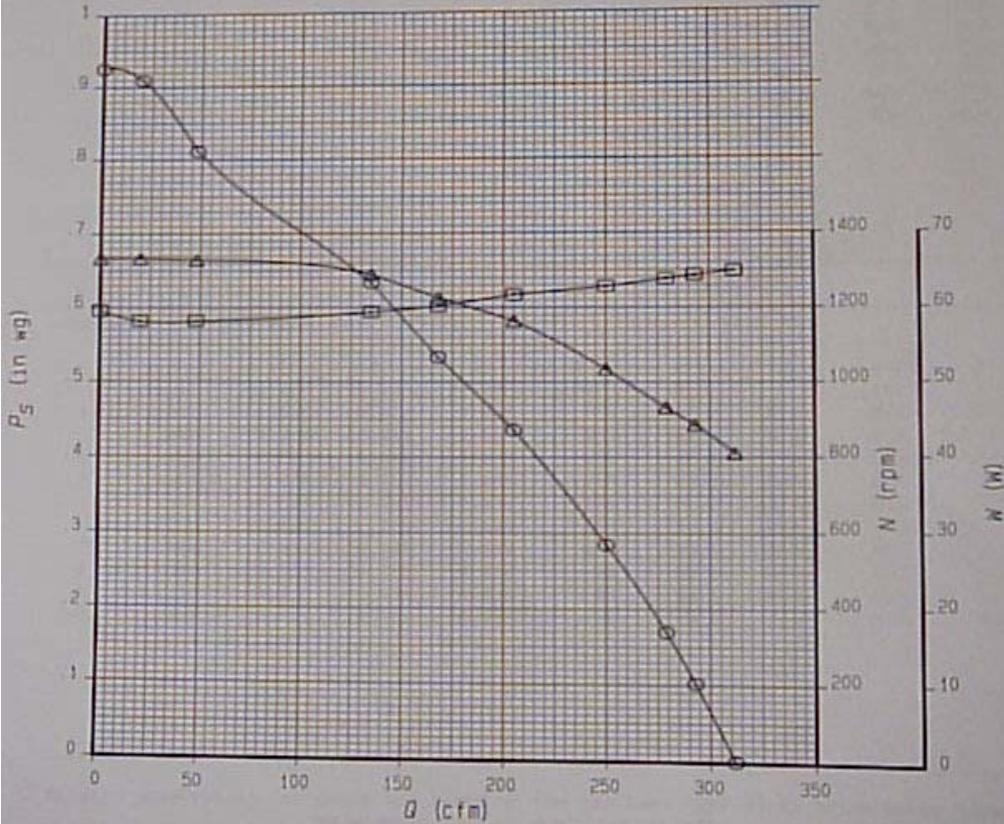
Unit: Ceiling Ventilator  
Manufacturer: Panasonic  
Trade Name: FV-30VG3  
Model Number: FV-30VG3  
Impeller Diameter: 7.375 in  
Inlet Area: .71 ft<sup>2</sup>  
Outlet Area: .16 ft<sup>2</sup>

Test Method per AMCA Standard 210-85, Figure 12, Installation Type B.  
Results at Standard Air.

Power is converted to standard air based on the fan laws applied to motor power input.

- LEGEND
- Fan Flow Rate, Q
  - Fan Static Pressure, P<sub>s</sub>
  - ◇ Motor Power Input, W
  - △ Fan Speed, N

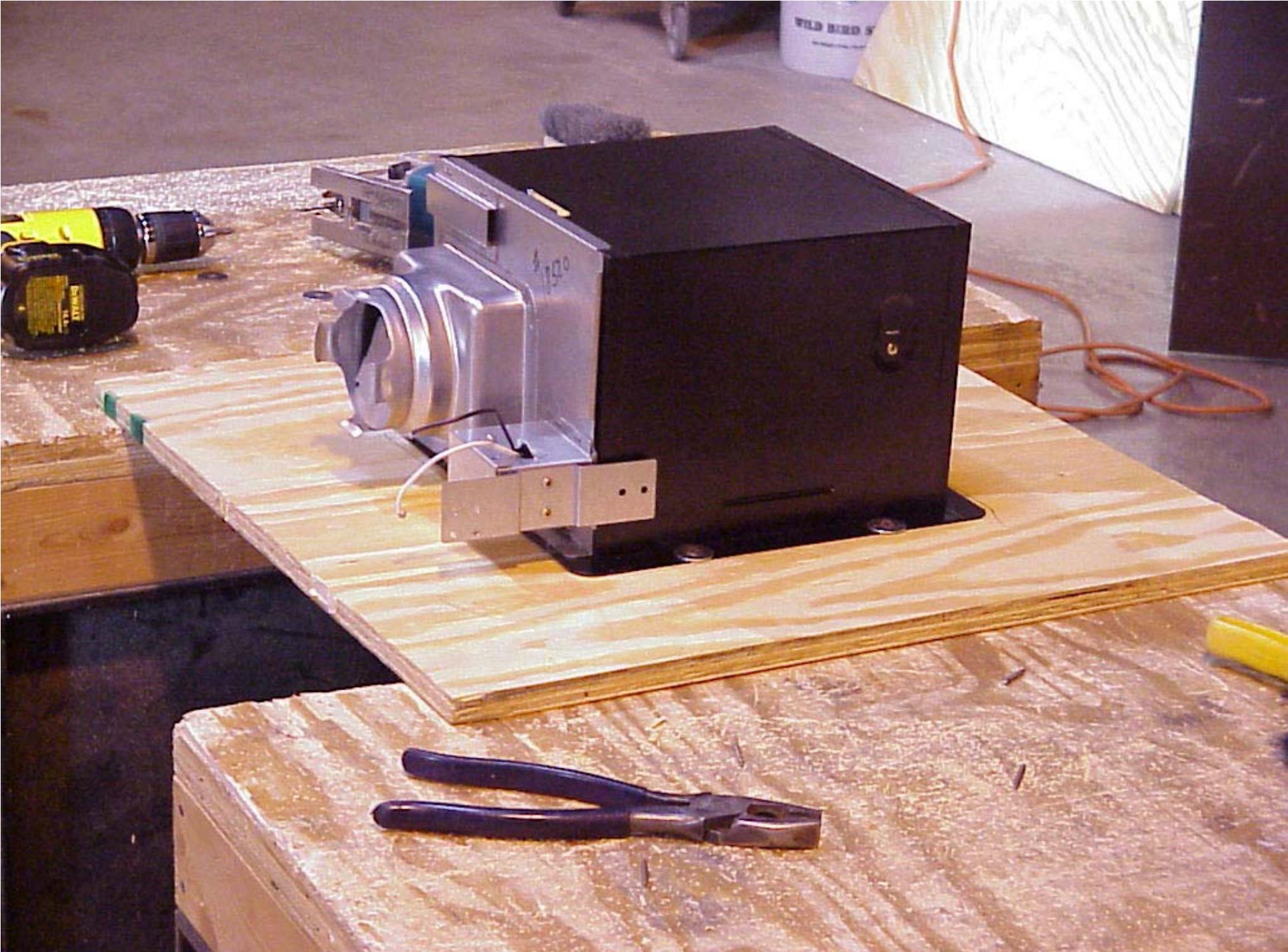
PRELIMINARY DATA



# Airflow curve

# Testing and Certification (cont.)

- Sound testing is done in a certified sound chamber
- A rotating microphone is used to measure sound power at 24 frequencies
- Sound room is concrete double-wall, isolated from the rest of lab, and “floats” on rubber cushions





Fan  
mounted  
in sound  
room



Rotating  
microphone  
(1 RPM)

# Testing and Certification (cont.)

- Sound measurements are analyzed by AMCA computer software
- Computer averages sound pressure level at 24 frequencies into 8 frequency bands
- Measurement of background noise and a standard Reference Sound Source are taken

# Sound Room computer setup



# Testing and Certification (cont.)

- Final output does weighted average of sone levels at 8 center frequencies
- This determines final sone rating

# Air Movement and Control Association International Inc.

30 West University Drive, Arlington Heights, Illinois, U.S.A., 60004-1893

HV1 Standard 915

Test Number: 18520-S1

Time: 7:41 pm, 2/15/02

### Determination Number: 1

AMCA Band Number:	1	2	3	4	5	6
Center Frequency (Hz):	50	63	80	100	125	160
$L_{w}$	31.5	29.7	29.5	33.2	43.8	46.1
$L_{p}$	12.8	17.1	15.4	17.6	16.1	14.2
$L_{w}-L_{p}$	18.9	12.6	14.1	15.5	27.8	31.9
$L_{w}-L_{p}$	00.1	00.2	00.2	00.1	00.0	00.0
$L_{w}$	31.4	29.5	29.3	33.0	43.8	46.1
$L_{p}$	2.7	6.0	9.6	6.4	4.3	5.5
$L_{w}-L_{p}$	34.1	35.5	39.0	39.5	48.2	51.6

AMCA Band Number:	3	4	5	6	7	8
Center Frequency (Hz):	200	250	315	400	500	630
$L_{w}$	44.9	46.4	45.3	43.6	41.4	41.6
$L_{p}$	18.0	8.4	5.2	13.6	4.2	0.7
$L_{w}-L_{p}$	26.9	38.0	40.2	30.0	37.2	40.9
$L_{w}-L_{p}$	00.0	00.0	00.0	00.0	00.0	00.0
$L_{w}$	44.9	46.4	45.3	43.6	41.4	41.6
$L_{p}$	3.4	3.7	2.7	2.3	2.3	2.6
$L_{w}-L_{p}$	48.3	50.1	48.1	45.9	43.7	44.2

AMCA Band Number:	5	6	7	8	9	10
Center Frequency (Hz):	800	1.0K	1.3K	1.6K	2.0K	2.5K
$L_{w}$	39.2	35.6	33.7	35.2	33.0	30.4
$L_{p}$	1.0	2.1	1.9	2.8	3.5	4.1
$L_{w}-L_{p}$	38.1	33.5	31.9	32.3	29.6	26.3
$L_{w}-L_{p}$	00.0	00.0	00.0	00.0	00.0	00.0
$L_{w}$	39.2	35.5	33.7	35.1	33.0	30.4
$L_{p}$	2.8	3.2	3.1	3.1	3.6	4.1
$L_{w}-L_{p}$	42.0	38.8	36.8	38.2	36.6	34.6

AMCA Band Number:	7	8	9	10	11	12
Center Frequency (Hz):	3.2K	4.0K	5.0K	6.3K	8.0K	10.0K
$L_{w}$	29.8	27.1	23.6	20.7	16.3	12.9
$L_{p}$	5.1	6.2	7.5	9.0	9.5	9.5
$L_{w}-L_{p}$	24.7	20.9	16.1	11.7	6.8	3.3
$L_{w}-L_{p}$	00.0	00.0	00.1	00.3	01.0	01.3
$L_{w}$	29.8	27.1	23.4	20.4	15.3	11.6
$L_{p}$	4.0	4.2	4.9	5.5	6.2	7.6
$L_{w}-L_{p}$	33.8	31.3	28.3	25.9	21.5	19.2*

Test Conditions at Fan Inlet  
 $P_s$  actual: 0.10 in. wg  
 $t_a$ : 68.0  
 $P_{s1}$ : 0.00 in. wg  
 $\rho$ : 0.073 lbm/ft<sup>3</sup>  
 $P_b$ : 29.11 in. Hg

# Sound report

Printed : 7:43 pm 2/15/02

# Air Movement and Control Association International, Inc.

30 West University Drive , Arlington Heights, Illinois, U.S.A., 60004-1893

AMCA Standard 301-90

Test Number: 18520-S1

AMCA Band Number:	1	2	3	4	5	6	7	8	Sones	Operating Point
Center Frequency (Hz) :	63	125	250	500	1K	2K	4K	8K		
Determination No. : 1										$P_s$ : 0.10 in. wg
Loudness index:	0.0	0.3	0.7	0.8	0.6	0.6	0.5	0.3*	1.7	$Q$ : 153 cfm
										$N$ : 974 rpm

# Testing and Certification (cont.)

- The final airflow and sound ratings are submitted by the manufacturer for certification by HVI
- HVI publishes certified results on web site ([www.hvi.org](http://www.hvi.org)) and in hard copy
- Certified Products Directory updated online monthly

HVI 911

September 2001



**CERTIFIED  
HOME VENTILATING PRODUCTS  
DIRECTORY**



93378 Home Ventilating Institute 9/01 **11d** RESID

# Energy Star Ventilation Equipment



- Low energy and quiet fans
  - Range Hoods max 4.0 sones, 2.8 cfm/w
  - Bath fans <75 cfm max 2.0 sones, 1.4 cfm/w
  - Bath fans 75-200 cfm max 1.5 sones, 2.8 cfm/w
  - Three year warranty required
- Bath fans, IAQ exhaust fans, & ceiling fans now
- Supply fans, inline fans, multiport fans, and air handlers in next two years
- Website: [www.energystar.gov](http://www.energystar.gov)



# Utility Promotion

- Cash incentives for quiet, low energy fans
  - \$50-125 incentives for 1.5 sone max fans with efficacy of 2 cfm/watt or better
- Program incentives/requirements
  - Seattle City Light Build Smart
    - 1.0 sone max fans with 35 watts max draw
  - Super Good Cents Manufactured Housing Program
    - 1.0 sone max fans delivering 50 or 70 cfm

# Questions?

## Don Stevens

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# VENTILATION TRAINING

## HRAI Residential Ventilation 2-Day Training Program Content

- **The Basics: IAQ, House as a System, Moisture Control, Ventilation Systems Types, Codes and Standards**
- **Good Ventilation Installation and Design Practices**
- **Duct Sizing Design Guide and Worksheets**
- **System Start-up**
- **Air-Flow Testing**
- **Depressurization Testing**
- **Service and Maintenance**
- **Contact: Joanne Spurrell 1-800-267-2231      [jspurrell@hrai.ca](mailto:jspurrell@hrai.ca)**