VENTING AND
COMBUSTION AIR

Roberts Mechanical Equipment Co.
ANSI Categories will tell you a great deal about the boiler and the application.
Understand the Table

Left side indicates a negative pressure.

Right Side indicates a positive pressure.
Top indicates non-condensing appliance (85% or less).

Bottom indicates condensing appliances (86% or more).
Examples (negative)

Atmospheric
Some fan assisted
Masonry Chimney
B-Vent material
Examples (Positive)

Forced Draft
Side wall vented
In line fan
UL Pressure stack or welded steel
Condensing / Non-Condensing

Effect of Inlet Water Temperature to Boiler Efficiency

natural gas = 1050 Btu/ft
Lining A Masonry Chimney (Cat. I)

Atmospheric – Clay Tile Liner

Fan Assisted – Clay Tile Liner (Interior)

Metal Liner (Exterior)

Exception: Clay tile liner can be used with exterior chimney if an Atmospheric appliance is connected to the same chimney

Reference: ANSI Z223.1-2002 10.4.1 and 13.1.9, NFPA211 4-2.2
Lining A Masonry Chimney (Category III)

Reference: ANSI Z223.1-2002 10.4.1 and 13.1.9, NFPA211 4-2.2
Lining A Masonry Chimney (Category II)

Fan Assisted—(85%+ Combustion Efficiency) AL29-4C

Reference: ANSI Z223.1-2002 10.4.1 and 13.1.9, NFPA211 4-2.2
Lining A Masonry Chimney (Category IV)

Fully Condensing – AL29-4C

Reference: ANSI Z223.1-2002 10.4.1 and 13.1.9, NFPA211 4-2.2
Safe Venting by Code

- Horizontal distances
- Large stack area
- Self venting connector rise
- Fan Min capacities
- Different type of appliances
- Existing masonry chimneys
- Location of draft inducer

National Fuel Gas Code
NFPA54 * IAS (A.G.A.) * ANSI Z 223.1
10.6.1.4 The total horizontal distance of a vent plus the horizontal vent connector serving draft hood-equipped appliances shall not be greater than 75% of the vertical height of the vent.

Table 13.1 and 13.2 The total horizontal length of the vent plus the vent connector for a single Category I appliance is:
100% of the height (vent 6 – 30 ft high); 30 ft (vent 31 – 50 ft high); 50% of the height (vent 51 – 100 ft high)

Common Violations

(NFPA 54) Z223.1-2002
(Venting of Equipment)
13.2.2 The maximum vent connector horizontal length shall be 18 in./in of connector diameter.

13.2.4 The length of the common vent manifold shall not exceed 18 in./in. of common vent diameter.

13.2.5 The horizontal length of the common vent offset shall not exceed 18 in./in. of common vent diameter.
Common Violations

(NFPA 54) Z223 Sizing Tables

1' Min. (3”-10” diameter)
2' Min. (12”-18” diameter)
4' Min. (20” and above)
13.2.17 Where two or more appliances are connected to a vertical vent or chimney, the flow area of the largest section of vertical or chimney shall not exceed seven times the smallest listed appliance categorized vent areas, flue collar area, or draft hood outlet area unless designed in accordance with approved engineering methods.

<table>
<thead>
<tr>
<th>Outlet Diameter</th>
<th>3&quot;</th>
<th>4&quot;</th>
<th>5&quot;</th>
<th>6&quot;</th>
<th>7&quot;</th>
<th>8&quot;</th>
<th>9&quot;</th>
<th>10&quot;</th>
<th>12&quot;</th>
<th>14&quot;</th>
<th>16&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Greater than 7 Times the Smallest Outlet Area</td>
<td>7&quot;</td>
<td>10&quot;</td>
<td>12&quot;</td>
<td>14&quot;</td>
<td>18&quot;</td>
<td>22&quot;</td>
<td>22&quot;</td>
<td>26&quot;</td>
<td>30&quot;</td>
<td>36&quot;</td>
<td>42&quot;</td>
</tr>
</tbody>
</table>

**Common Violations**

**(NFPA 54) Z223.1-2002 13.2.17**

(Sizing of Venting Systems)
10.10.4.2 Vent connectors serving Category I appliances shall not be connected into any portion of mechanical draft systems operating under positive static pressure, such as those serving Category III or Category IV appliances.

Common Violations

(NFPA 54) Z223.1-2002
10.10.4.2 (Venting of Equipment)
Common Violations

10.5.4.3 Masonry chimneys shall be built and installed in accordance with NFPA 211.

4-2.2 Masonry chimneys shall be lined...Cat II, III and IV gas appliances - special gas vents listed for installation within masonry chimneys.

(NFPA 54) Z223.1-2002 10.5.4.3
(NFPA 211) 4-2.2
10.3.3 Forced draft systems and all portions of induced draft systems under positive pressure during operation shall be designed and installed so as to prevent leakage of flue or vent gases into a building.

10.3.4 Vent connectors serving equipment vented by natural draft shall not be connected into any portion of mechanical draft systems operating under positive pressure.
503.6.9.3 Mechanical draft. Chimney venting systems using mechanical draft shall be sized in accordance with approved engineering methods.

10.5.3.1 Size of Chimneys. Chimney venting systems using mechanical draft shall be sized in accordance with approved engineering methods.

International Fuel Gas Code - Section 503 (Venting of Equipment)

Z223.1-2002 Standard for Venting of Equipment

Resolving Codes using Mechanical Draft System
System should be UL listed (as a designed system).
- System must Monitor proper draft at all times.
- System must interlock, alarm and lock out appliances.
- System must be supplied with engineering (Acceptable Engineering Method) specific to installed appliances.
- System should modulate to match today’s efficient appliances.
- System performance should be guaranteed.

Mechanical Draft System (Check List)
<table>
<thead>
<tr>
<th>Category</th>
<th>Characteristic</th>
<th>Type</th>
<th>Draft</th>
<th>Vent</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Non-CondensingNegative pressure</td>
<td>Natural draft appliance and fan assisted &lt; 86 % efficient</td>
<td>Draft hood: Negative Fan-assist: - 0.02 to - 0.08</td>
<td>B-Vent</td>
</tr>
<tr>
<td>II</td>
<td>CondensingNegative pressure</td>
<td>Fan assisted appliance &gt; 86 % efficient</td>
<td>Fan-assist: - 0.02 to - 0.08</td>
<td>AL29-4C</td>
</tr>
<tr>
<td>III</td>
<td>Non-CondensingPositive pressure</td>
<td>Forced draft / Direct Vent &lt; 86 % efficient</td>
<td>Positive</td>
<td>Forced Draft (Pressure stack) Direct Vent (AL29)</td>
</tr>
<tr>
<td>IV</td>
<td>CondensingPositive pressure</td>
<td>Fan assisted/ Pulse</td>
<td>Positive</td>
<td>AL29-4C</td>
</tr>
</tbody>
</table>

**Vent Category Review**
8.3.3.2 One Permanent Opening Method: One permanent opening, commencing within 12 in. of the top of the enclosure, shall be provided. The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces that freely communicate with the outdoors and shall have a minimum free area of the following:

1 in.²/3000 Btu of the total input rating of all equipment located in the enclosure, and not less than the sum of the areas of all vent connectors in the space.

Combustion Air Code

Z223.1-2002 8.3.3 Outdoor Combustion Air.
Louver(s) Sizing:
1 sq.in./4000 Btu per louver
4000 MBH = 1000 in² of free area per louver.

Typical louver has 30-60% free area.

Depending on louver design actual louver size will be:

Using 45% free area louvers
= Two 5’ x 4’ louvers

Tip: Check with the Louver Manufacturer for accurate ‘free space’ than watch equal products in the submittals.
<table>
<thead>
<tr>
<th></th>
<th>NFPA 54 gas</th>
<th>NFPA 31 oil</th>
<th>BOCA all</th>
<th>SBCCI gas &amp; oil</th>
<th>SBCCI solid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum No. openings required</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Outdoor opening, sq. in./Btu/h</td>
<td>1/4000</td>
<td>1/4000</td>
<td>1/4000</td>
<td>1/4000</td>
<td>2/1000</td>
</tr>
<tr>
<td>Vertical ducts, sq. in./Btu/h</td>
<td>1/4000</td>
<td>1/4000</td>
<td>1/4000</td>
<td>1/4000</td>
<td>-</td>
</tr>
<tr>
<td>Horizontal ducts, sq. in./Btu/h</td>
<td>1/2000</td>
<td>1/2000</td>
<td>1/2000</td>
<td>1/2000</td>
<td>-</td>
</tr>
<tr>
<td>Ducts same as opening</td>
<td>yes</td>
<td>yes</td>
<td>-</td>
<td>yes</td>
<td>-</td>
</tr>
<tr>
<td>Minimum duct dimension, inches</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Louver &amp; grill free area</td>
<td>opening</td>
<td>opening</td>
<td>-</td>
<td>-</td>
<td>opening</td>
</tr>
<tr>
<td>Free area allowance, wood*</td>
<td>20-25%</td>
<td>20-25%</td>
<td>25%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Free area allowance, metal*</td>
<td>60-75%</td>
<td>60-75%</td>
<td>75%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Damper interlocked</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*use manufacturer's free area rating when available.
Total fuel input rate of all fuel-burning devices located in the boiler room considered.

The Btu rate per hour of all boilers at maximum burning rate, plus other devices such as water heaters, are used to size air openings.

Outside air openings sizing must be done based on its free area. (Protective mesh must be no smaller than 0.25 inch to minimize dirt build-up or obstruction.
Direct Connect Combustion Air

- Best with Fan Assisted Appliances.
- Roof or Single side.
- Careful combining Combustion air intakes.
- Watch Horizontal lengths (fitting equal 10').
- FREEZE PROTECTION

**Tip:** Freeze protection should be proven damper system operating in the specific boiler sequence. Allows combining inlet also prevent freezing without power.
8.3.6 Mechanical Combustion Air Supply. Where all combustion air is provided by a mechanical air supply system, the combustion air shall be supplied from outdoors at the minimum rate of 0.35 ft³/min per 1000 Btu/hr for all appliances located within the space.

8.3.6.1 Where exhaust fans are installed, additional air shall be provided to replace the exhausted air.

8.3.6.2 Each of the appliances served shall be interlocked to the mechanical air supply system to prevent main burner operation where the mechanical air supply system is not in operation.

Combustion Air Code

Z223.1-2002
Mechanical Combustion Air

Tip: Multiple water heaters or boilers running high efficiency firing rates warrant a modulating combustion air system.

- Guaranteed to provide proper combustion air.
- Small opening / more aesthetic.
- Solves Code Issues
Louver Sizing:
Engineered using ASHRAE Chimney Design Equation.

Flue Gas Volume corrected for temperature = 1,400 cfm of combustion air

1400 cfm/500 fpm = 2.8 ft² of louver free area

Using a 45% free area louver = One 3’ x 2’ louver

Tip: Be sure to consider any mechanical exhaust in the boiler. Fan must keep up with all ventilation as well.
NORMAL OPERATION

Barometric Damper is weighted to open and ‘break’ draft by mixing a % of room air.

The chimney is drawing at a specific rate, but now draws from the water heater/boiler and room.

Typical draft for negative commercial appliances is -.02 to -.08.

Tip: Use a barometric damper on stacks over 25' or 30' as long as the appliance is category I or II (negative).
The Barometric Damper

**Negative Mech Room:**

- Room goes negative.
- Barometric is pulled into the room.
- The barometric becomes a source of make up air for the room.
- Problem is, this make up air is deadly.

**Tip:** Pay close attention to the combustion air in a room. Look for sources of problems such as old leaky returns.
More Information / Additional Training:

Roberts Mechanical Equipment
P: 216-587-0005
F: 216-587-0008

Or visit our industry leading web site at:

www.robertsmech.com

Written by/Property of: Grant Roberts

Thank You!