Airex University

Venting: Design, Sizing & Layouts

November 26, 2015
• **Presentation Topics**

  • Boilers
    • Categories
    • Draft calcs.
    • Layouts
    • Common Venting
    • Cases & Examples

  • Components & Design
    • Specs
    • Wall & Roof Terminations
    • Expansion
    • Supports
    • Starting Adapters
    • Mech. Chase & Masonry
• **Presentation Topics**

  • Generators
    • Design Recommendations
  
  • Good Practices
    • Do’s & Don’ts

  • Freestanding
    • Types
    • Options
Boilers are divided into four categories based on the pressure and temperature produced in the exhaust stack and the likelihood of condensate production in the vent.
Cheminee Lining
Boiler Venting: Design, Categories

**CATEGORY I**
- Atmospheric Boilers
  - Take air from draft hood
- Fan assisted
  - May require Barometric damper
- Forced draft
  - Neutral pressure at boiler outlet
- Common venting allowed
- Efficiency 83% or less

**CATEGORY II**
- High-Efficiency
- Fan assisted
- Common venting allowed
- Efficiency 84% or more

**CATEGORY III**
- Forced draft
  - Neutral pressure at boiler outlet
- Cannot be common vented
- Side-wall venting allowed
- Efficiency 83% or less

**CATEGORY IV**
- Barometrics not allowed
- Cannot be common vented
- Predetermined Equivalent lengths
- Side-Wall venting allowed
- Efficiency 84% or more
### Factors

<table>
<thead>
<tr>
<th>Factors</th>
<th>Increases draft</th>
<th>Decreases draft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass flow</td>
<td></td>
<td>(\downarrow)</td>
</tr>
<tr>
<td>Exhaust temperature</td>
<td>(\uparrow)</td>
<td></td>
</tr>
<tr>
<td>Horizontal length</td>
<td>(\downarrow)</td>
<td></td>
</tr>
<tr>
<td>Vertical height</td>
<td>(\uparrow)</td>
<td></td>
</tr>
<tr>
<td>Fittings</td>
<td></td>
<td>(\downarrow)</td>
</tr>
<tr>
<td>Diameter</td>
<td>(\uparrow)</td>
<td>(\downarrow)</td>
</tr>
<tr>
<td>Heat loss</td>
<td></td>
<td>(\downarrow)</td>
</tr>
<tr>
<td>Site elevation</td>
<td></td>
<td>(\downarrow)</td>
</tr>
<tr>
<td>Cold Vs Hot weather</td>
<td>(\uparrow)</td>
<td>(\downarrow)</td>
</tr>
</tbody>
</table>

**Point of draft measurement / estimation**

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*Boiler Venting: Draft*
Minimum Requirements

- Boiler Make, Model and HP
- Exhaust Temperature
- Layout (lengths and fittings)
- Building elevation OR Total Stack height
- Site Location

Calculated values

- Mass Flow (lbs/h)
- Density (lbs/ft³)
- Volumetric Flow (cfm)
- Velocity (ft/sec)
- Theoretical draft (in. wc)
- Total losses (in. wc)
- Available draft (in. wc)
### Preferable Draft Range (Single Boiler application)

- **Forced firetube boiler**
  - \( \leq 0.1 \) in. wc, No economizer
  - \( \leq 0 \) in. wc, With economizer

### Multiple Boiler application

- \( \leq 0 \) in. wc, With or without economizer

**Draft Calcs based on ASHRAE Handbook:**

#### COMPONENTS

<table>
<thead>
<tr>
<th>Flue</th>
<th>Qty / length</th>
<th>Chimney</th>
<th>Qty / length</th>
</tr>
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<tbody>
<tr>
<td>Draft hood</td>
<td>0.00</td>
<td>45° elbow</td>
<td>2.00</td>
</tr>
<tr>
<td>Barometric control</td>
<td>0.00</td>
<td>90° elbow</td>
<td>0.00</td>
</tr>
<tr>
<td>Control damper</td>
<td>0.00</td>
<td>Transition</td>
<td>0.00</td>
</tr>
<tr>
<td>Increaser</td>
<td>0.00</td>
<td>Increaser</td>
<td>0.00</td>
</tr>
<tr>
<td>Reducer</td>
<td>0.00</td>
<td>Reducer</td>
<td>0.00</td>
</tr>
<tr>
<td>45° elbow</td>
<td>0.00</td>
<td>45° tee connection</td>
<td>0.00</td>
</tr>
<tr>
<td>90° elbow</td>
<td>0.00</td>
<td>90° tee connection</td>
<td>0.00</td>
</tr>
<tr>
<td>90° Tee connection</td>
<td>0.00</td>
<td>Boot tee connection</td>
<td>0.00</td>
</tr>
<tr>
<td>45° Tee connection</td>
<td>0.00</td>
<td>Rain cap</td>
<td>1.00</td>
</tr>
<tr>
<td>Boot Tee connection</td>
<td>0.00</td>
<td>Exhaust cone</td>
<td>0.00</td>
</tr>
<tr>
<td>Flue length</td>
<td>1.00 ft</td>
<td>Chimney height</td>
<td>12.00 ft</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Component</th>
<th>Qty / length</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flue diameter</td>
<td>16.00 in</td>
<td>406 mm</td>
</tr>
<tr>
<td>Gas speed within the flue</td>
<td>28.18 ft/s</td>
<td>8.59 m/s</td>
</tr>
<tr>
<td>Chimney diameter</td>
<td>16.00 in</td>
<td>406 mm</td>
</tr>
<tr>
<td>Gas speed within the chimney</td>
<td>28.18 ft/s</td>
<td>8.59 m/s</td>
</tr>
<tr>
<td>Exit diameter</td>
<td>16.00 in</td>
<td>406 mm</td>
</tr>
<tr>
<td>Gas speed at exit point</td>
<td>28.18 ft/s</td>
<td>8.59 m/s</td>
</tr>
<tr>
<td>Natural draft</td>
<td>-0.045 in w.c.</td>
<td>-11.2 Pa</td>
</tr>
<tr>
<td>Forced pressure</td>
<td>0.000 in w.c.</td>
<td>0.0 Pa</td>
</tr>
<tr>
<td>Pressure loss</td>
<td>0.122 in w.c.</td>
<td>30.4 Pa</td>
</tr>
<tr>
<td>Available draft</td>
<td>0.077 in w.c.</td>
<td>19.2 Pa</td>
</tr>
</tbody>
</table>
Minimum Requirements

- Boiler Make, Model and HP
- Exhaust Temperature
- Layout (lengths and fittings)
- Building elevation OR Total Stack height
- Site Location

Additional Information

- Boiler to breeching connections
- Fittings
- Placement of dampers and Barometrics
- Layout restrictions
- Required termination
Multiple Boiler application draft

- ≤0 in. wc

Cat I boiler

- A barometric may be required but not necessary.
- Barometric to limit excess draft
- Condensate tee as close to outlet in order to limit condensation back to boilers
- It is best to place boilers from weakest to strongest towards the vertical stack
- Consult Boiler Manual for Draft range

Draft Calcs based on ASHRAE Handbook.
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Combined Boiler Venting:
Typical breeching connections

+ Good draft flow       -  Higher space needed
+ Clean-out access

+ Good draft flow       -  Higher space needed
+ Clean-out access     -  No clean-out access
+ Gradual sizing increase

+ Good draft flow       -  Not ideal for condensing application
+ Clean-out access
+ lower head room

+ Minimum head room       -  Restrictive draft flow
+ Clean-out access
-  Can cause back pressure
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Combined Boiler Venting: Tips

Airex University: Exhaust Venting
Airex University: Exhaust Venting

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**Boiler Venting: Economizer Exhaust**

- 316 Inner wall
- Drain
- Test port
- 316 Stainless steel flange
- Sleeve

Neutral draft at economizer outlet
Draft Control Systems:

- Sequencing of multiple boilers on common breeching
- Bypass on draft fan applications
- Reduce heat loss after shut down
- Limits draft on tall vertical stacks
- Balances draft on multiple boiler applications
- Interlock application
COMPONENTS, DESIGN & INSTALL
ULC LISTINGS:

UL 103 Industrial Positive Pressure
- 1400 F continuous operation
- 60 in. wc.
- Category I & III Appliances & Generator Exhausts

UL 1738 Special Gas Vent
- 550 F continuous operation
- 2.5X manufacturer tested pressure (minimum 1.25 in. wc.)
- Category II, III & IV Appliances
- AL29-4C is not the only approved material for condensing application
INSULATION

AIR SPACE
- UL APPROVED FOR 1400° F CONTINUOUS
- PEAKS OF 1800° F FOR 10 MINS.

CHEMINÉE LINING:
- AVAILABLE IN 1” & 2”

MINERAL FIBER
- UL APPROVED FOR 1000° F CONTINUOUS
- PEAKS OF 1400° F FOR 10 MINS.

CHEMINÉE LINING:
- AVAILABLE IN 1” & 2”

CERAMIC FIBER
- UL APPROVED FOR 1400° F CONTINUOUS
- PEAKS OF 1800° F FOR 10 MINS.

CHEMINÉE LINING:
- AVAILABLE IN 1”, 2” & 4”
Male-to-female jointing system design prevents sealant attack by exhaust gases while reducing installation time.
VENT HEIGHT ABOVE ROOF

CSA Code 8.14.2 :
• Negative vent must have a minimum 2’ above any portion of a building within a horizontal distance of 10’

CSA Code 8.14.3 :
• Positive vent must have a minimum of 18” above highest point within a horizontal distance of 18”

Pitched Roof
CSA Code 8.14.4 :
• Must be not less than 3’ above highest point where it passes through the roof and not less 2’ higher than any portion of a building within a horizontal distance of 10’
VENT HEIGHT ABOVE ROOF

Do this

Vent less than 10 ft (3 m) from wall
Locate rain cap not less than
2 ft (600 mm) above wall

Never do this

More than 10 ft (3.1 m)
Height above any roof surface within 10 ft (3.1 m) horizontally

Chimney, 3 ft (0.92 m)
minimum; gas vent or
Type L vent, 2 ft (0.61 m)
minimum

Chimney or vent

2 ft (0.61 m)
minimum

Chimney or vent

2 ft (0.61 m)
minimum

Chimney or vent

2 ft (0.61 m)
minimum

Chimney or vent

2 ft (0.61 m)
minimum

Chimney or vent

Wall or parapet

Chimney or vent

2 ft (0.61 m)
minimum

Chimney or vent

2 ft (0.61 m)
minimum

Chimney or vent

2 ft (0.61 m)
minimum
SUPPORT OPTIONS FOR EXTENDED HEIGHT ABOVE ROOF

• STANDARD FREESTANDING HEIGHT IS 10’
• MUST HAVE SUFFICIENT VERTICAL SUPPORT
• WILL REQUIRE GUYING AT INTERVALS
• OR OTHER LATERAL SUPPORTS
  (ROOF BAND, GUIDES WITH STEEL STRUCTURE)
• ROOF BAND OPTION WILL REQUIRE STRUCTURAL
  ROOF CURB TO SUPPORT
• A MAXIMUM OF TWO SUPPORTING OPTIONS ARE
  RECOMMENDED ON A SINGLE STACK, LIMITING
  THE TOTAL HEIGHT ALLOWED
TYPICAL ROOF PENETRATION ASSEMBLY

ROOF CURB INSTALL

FLAT ROOF INSTALL

12” OR 18”
SLEEVE PENETRATION ASSEMBLY

Note: Proper framing of openings for combustible roof applications must meet specified clearance I. D. +1/2" and is the responsibility of the installing contractor.
SUPPORTS BELOW ROOF

NOT RECOMMENDED
WITH GUY WIRE BANDS
WALL PENETRATION:
INSULATED WALL FIRE STOP
WALL PENETRATION: UN-INSULATED OPTION
WALL TERMINATIONS

MITER SECTION WITH 45° ELBOW

JOINT MUST BE CLEAR OF WALL PENETRATION

BIRD SCREEN OPTIONAL

WALL TERMINATION TEE

BIRD SCREENS OPTIONAL
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**COMPONENTS & SUPPORTS**

**ROOF TERMINATIONS**

- **RAIN CAP**
  - Bird Screen Option
  - Not recommended on condensing application
  - Must be reinforced past 24” ø ID
  - Added draft restriction

- **EXHAUST CONE**
  - Bird Screen Not recommended
  - Added draft restriction
  - Increases velocity at outlet

- **RAINSHIELD**
  - Reduces rain water inside stack
  - Not available past 16” ø ID
  - No draft loss

- **CLOSURE SECTION**
  - Open ended
  - No draft loss
  - Recommended for condensing application

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Airex University: Exhaust Venting
EXPANSION COMPONENTS

EXPANSION JOINT
• GEN. SET APPLICATION

VARIABLE LENGTH
• NON-CONDENSING BOILER APPLICATION

ADJUSTABLE LENGTH
• CONDENSING BOILER APPLICATION
• NOT RECOMMENDED FOR EXPANSION

*SEE DETAILS IN INSTALL GUIDE
HORIZONTAL SUPPORTS

HANGER BRACKETS

HORIZONTAL SUPPORT
VERTICAL SUPPORTS

ANCHOR PLATE

WALL SUPPORT

SUSPENSION BAND
LATERAL SUPPORTS

FLOOR GUIDE

WALL GUIDE

ROOF SUPPORT

ROOF SUPPORT
STARTING ADAPTERS

BOILER OUTLET

TEST PORT

DAM

DRAIN

HORIZONTAL DESIGN

TEST PORT

FLANGE
• CARBON
• 304
• 316
• 150LBS

ELIPSE

DRAIN

VERTICAL DESIGN
STARTING ADAPTERS
ALTERNATE OPTIONS

SAD / ELBOW

SA OFFSET (CONDENSING)
STARTING ADAPTERS
**MASSONRY CHIMNEY**
- Base Tee supported
- Support at breeching connection (wall support)
- Single wall stack
- Will need lateral supports

**MECHANICAL CHASE**
- Support at breeching connection (wall support)
- Double wall stack
- Will need lateral supports
- Will need to have a ventilated flashing & collar
Consult our parts catalogue and installation guide for additional information

chemineelining.com
GOOD
GOOD

Cheminee Lining
Good Design Practices
GOOD

Cheminee Lining
Good Design Practices
GOOD

Cheminee Lining
Good Design Practices
BAD
BAD
BAD
BAD
TRY NOT TO
TRY NOT TO
TRY NOT TO
• Relief Valve
• Fixed support at each change of direction
• Expansion joint before fixed support
• Insulated Roof and Wall penetrations
• **Design considerations**
  - Local Codes, regulations and information provided
  - Combustion equipment and application
  - Chemical & thermal conditions
  - Protection of personnel
  - Structural analysis including wind, seismic, and vortex loads

• **Available Accessories**
  - Access door & Stack drainage
  - Platforms & ladders
  - Lightning protection
  - Spoiler & other anti-vortex equipment
  - Climbing device with protection
  - Test ports
  - FAA lights
FREESTANDING MODELS

**STS**
- Single Structural Shell

**STS2**
- Inner Structural Shell With Insulation And Outer Metal Jacket

**STS3**
- Outer Structural Shell With Air Space, Insulation And Steel Lining

**STSR**
- Outer Structural Shell With Refractory Lining
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FREESTANDING STACKS
• Cryogenic Vent*
• Heater
• Boiler
• Thermal Oil Boiler
• Water Heater
• Direct-Contact Water Heater
• Cooking Oven (Gas)
• Cooking Oven (Vapor)
• Industrial Oven
• Industrial Cooker
• Fuel Cell

• Hot Air Generator
• Tempered Air Generator
• Generator
• Ventilation Hood (Grease)
• Ventilation Hood (No Grease)
• Dehumidifier
• Incinerator
• Pressure Washer
• Percotherm
• Fire Pump
• Coffee Roaster
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