

Dealing with the products of combustion

- ▶ **Flue gas issues and solutions**
- ▶ **Condensate issues and solutions**



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Dealing with the products of combustion

Objective of this session:

Create awareness of issues related to condensing boilers

What will be covered:

- ▶ How condensing boilers create flue gas and condensate
- ▶ Venting options and challenges
- ▶ Condensate disposal options and challenges

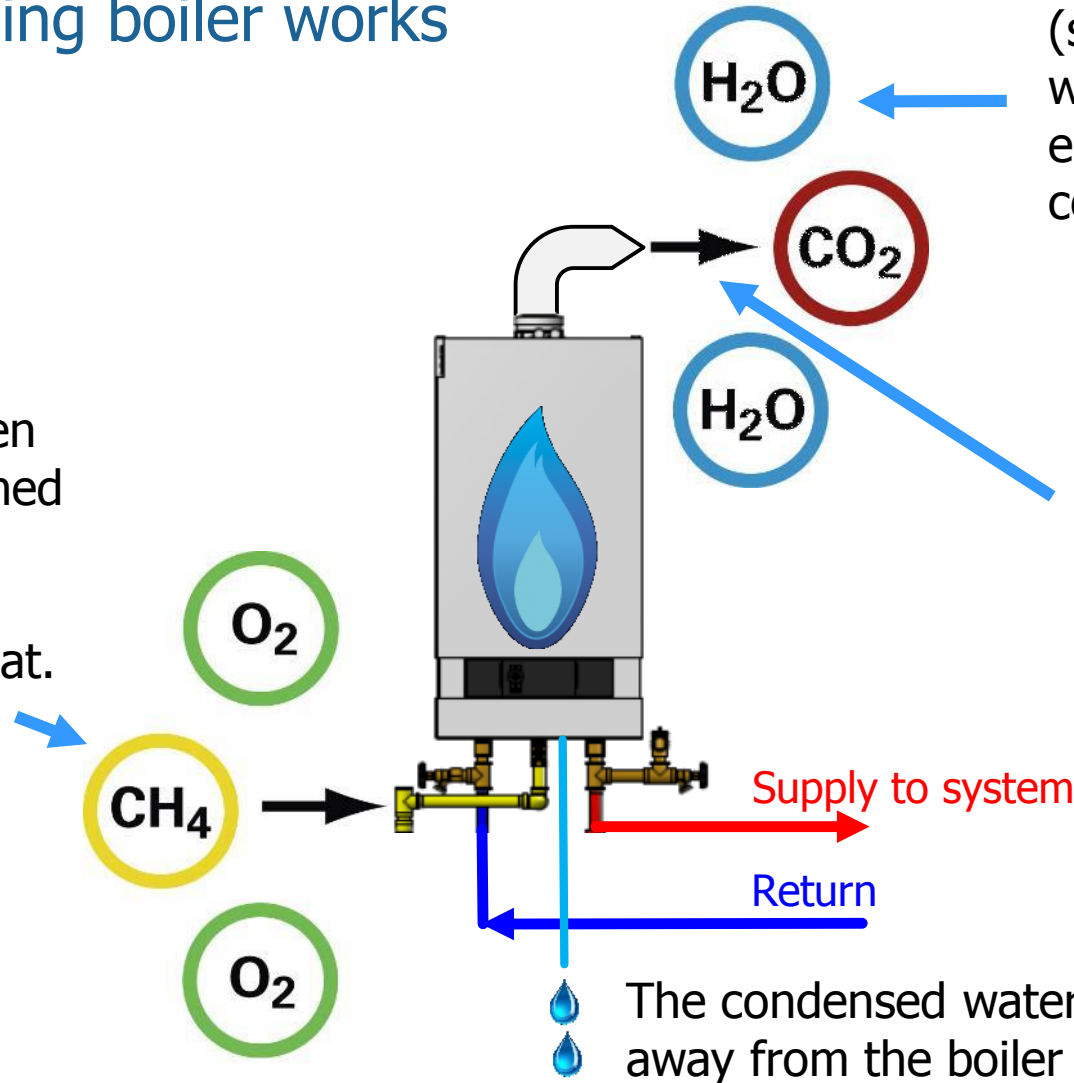
Recent Changes To Federal Energy Efficiency Regulations

- ▶ On June 3, 2019 NRCan Amendment 15 to Canada's Energy Efficiency Regulations was published
- ▶ New minimum efficiency regulations relating to gas fired boilers and water heaters:
 - ▶ **2020** – All instantaneous water heaters must be condensing (0.86 - 0.87 UEF depends on flow rate)
 - ▶ **2023** – All household gas boilers <300 MBH must be condensing (minimum 90% AFUE)
 - ▶ **2025** – All commercial gas boilers >300 MBH must be condensing (minimum 90% efficiency, TE or CE depending on size)

Heat recovery from flue gases

How a condensing boiler works

Natural gas and oxygen (in the air) are combined and ignited inside the boiler creating both **sensible** and **latent** heat.



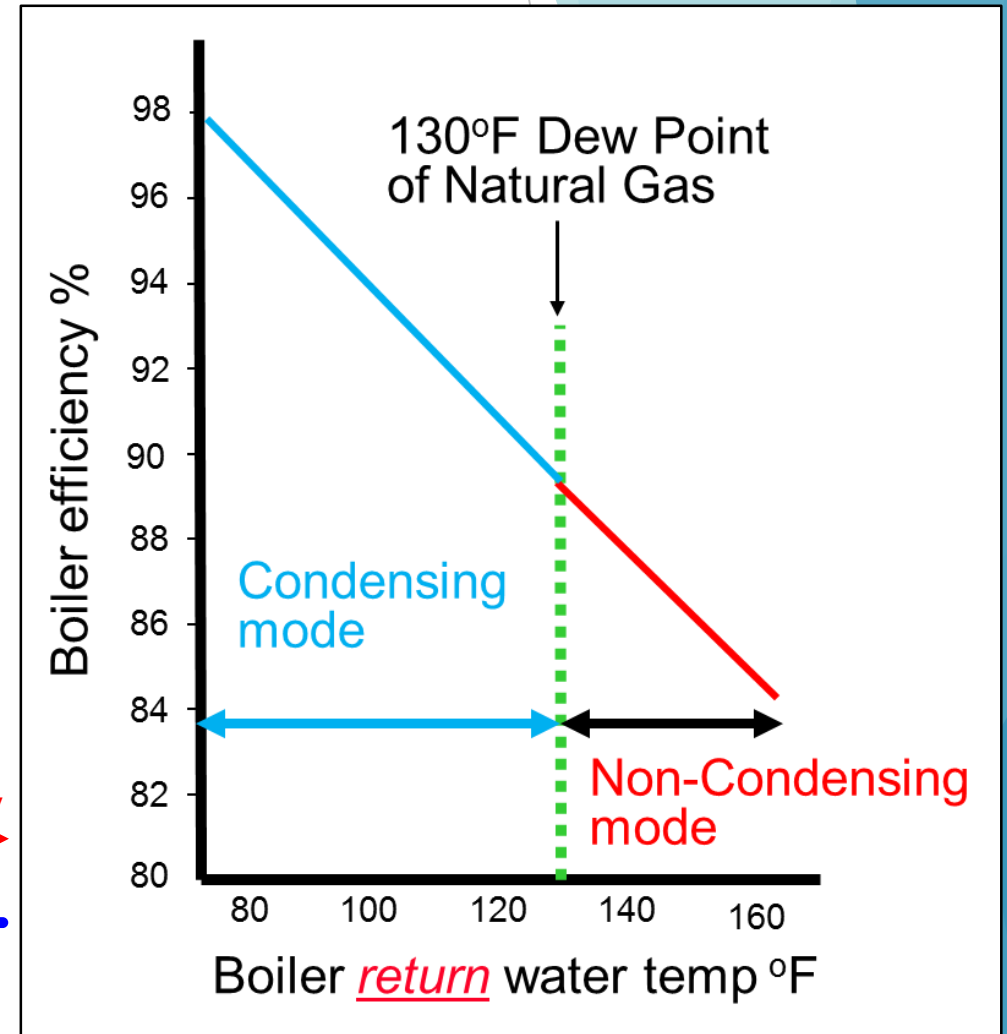
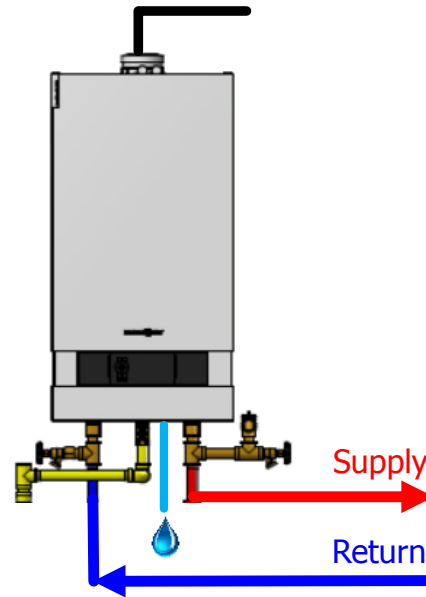
The flue gas contains water vapor (steam) and carbon dioxide. The water vapor will release extra energy to the system when condensed *inside* the boiler.

The flue gas temperature is much lower than non-condensing boiler (usually 160 - 200°F).

Heat recovery from flue gases

How a condensing boiler works

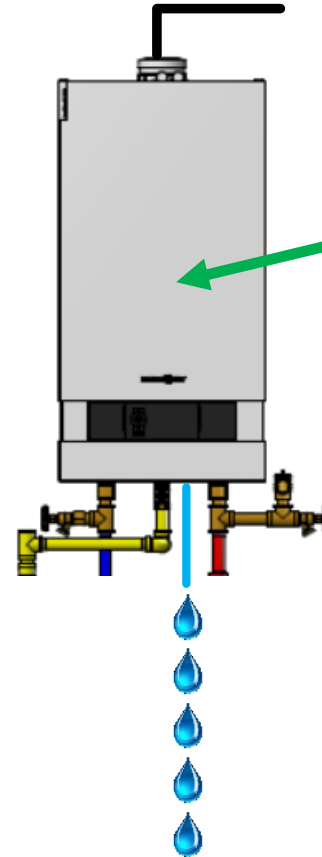
- ▶ A condensing boiler *does not always condense*. It starts to condense when the return water temp is below 130°F
- ▶ The **lower** the temp, the **more** condensation, the **higher** the efficiency.



Heat recovery from flue gases

Flue gas condensation

- ▶ Flue gas condensate is **acidic** water with a pH $\sim 4 - 5$
- ▶ Condensate is **very corrosive** to many metals, especially carbon steel and copper.
- ▶ Condensing boiler heat exchangers are usually made of **stainless steel** to provide longevity.



Viessmann stainless steel heat exchanger

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- ▶ The effects of corrosive flue gas condensate on metal vent pipe



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Part 1: Venting Options and Challenges

- ▶ **Venting material options**
- ▶ **Venting challenges and issues**

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Condensing boiler venting material options:

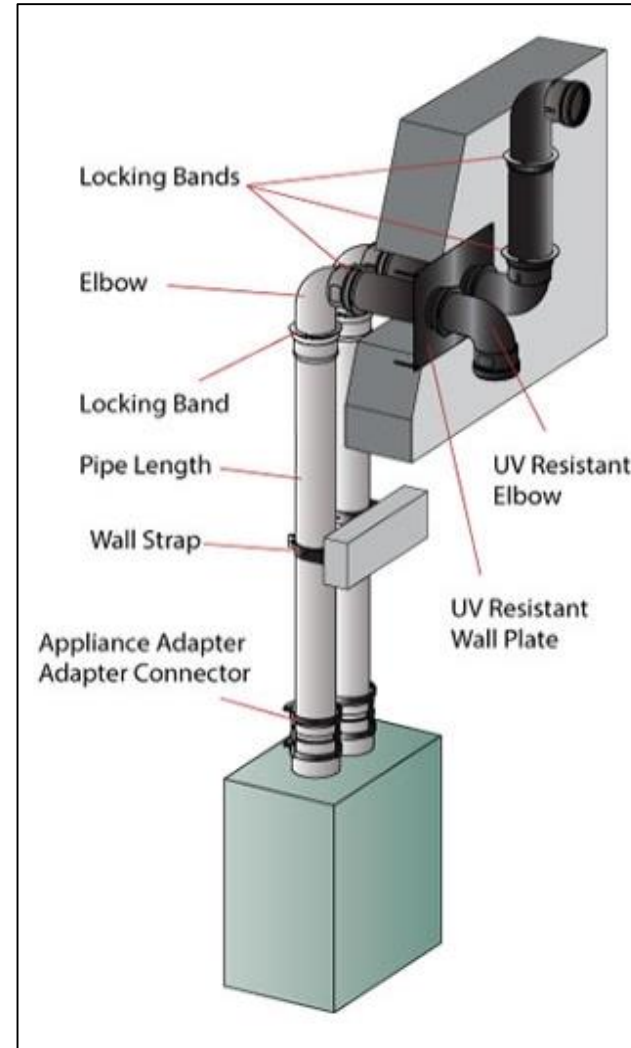
Venting Material	Temperature rating	Joining method	Flexible pipe option
PVC	65°C (149°F)	Solvent welding	NO
CPVC	90°C (194°F)	Solvent welding	NO
Polypropylene	110°C (230°F)	Gasketed fitting	YES
Stainless steel	249°C (480°F)	Gasketed fitting	YES



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Side wall venting

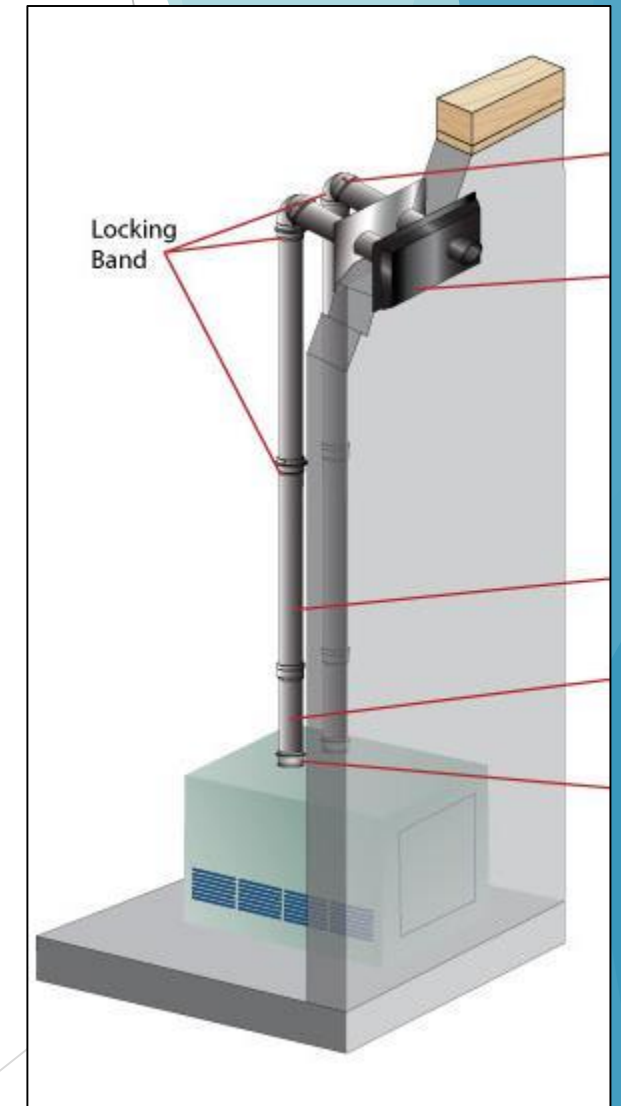
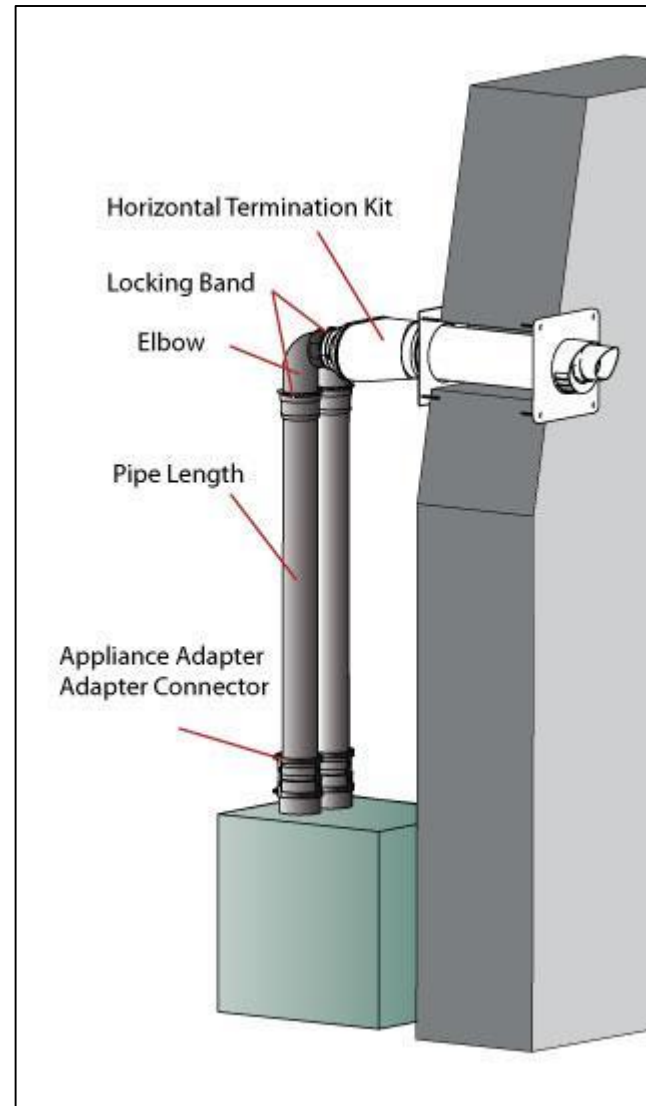
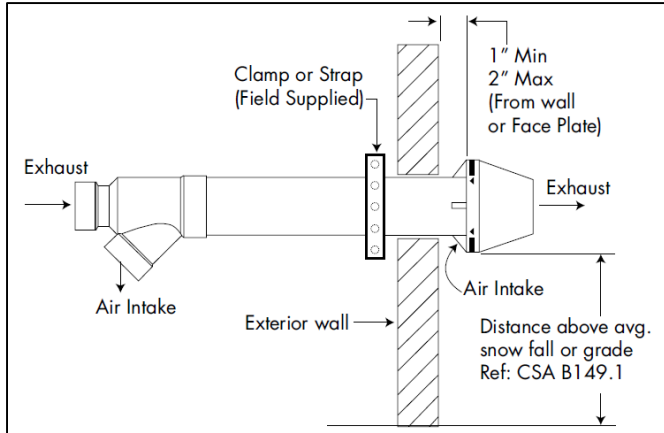
- ▶ Two pipe terminations



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Side wall venting

► Concentric vent terminations



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CSA B149.1 Article 8.14.8 states that a vent shall not terminate:

- Where it may cause hazardous frost or ice accumulations on adjacent property surfaces.
- Less than 7 feet (2.1 m) above a paved sidewalk or a paved driveway that is located on public property.
- Within 6 feet (1.8 m) of a mechanical air-supply inlet to any building.
- Within 3 feet (900 mm) horizontally of the vertical centerline above the gas service regulator vent outlet to a maximum vertical distance of 15 feet (4.5 m).
- Less than 1 foot (300 mm) above grade level.
- Within 12 inches (300 mm) of a window or door that can be opened in any building, of any non-mechanical air-supply inlet to any building, or of the combustion air inlet of any other appliance for gas units up to and including 100,000 BTU/hr (30 kW).
- Within 3 feet (900 mm) of a window or door that can be opened in any building, of any non-mechanical air-supply inlet to any building, or of the combustion air inlet of any other appliance for gas units exceeding 100,000 BTU/hr (30 kW).

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**So what's the big deal
with sidewall venting?
What can go wrong?**

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Issues with side wall venting

- ▶ Plumes of flue gas exiting building close to ground
- ▶ Contact with walls, windows, driveways, adjacent buildings, etc
- ▶ Damage to landscaping, facades
- ▶ Angry neighbours!
- ▶ Moisture getting into attic through soffits
- ▶ Ice formation
- ▶ Flue gas recirculation
- ▶ Contamination of ventilation air

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Too close to neighbour

- ▶ New side wall venting regulations in BC, AB and SK introduce new restrictions
 - ▶ Minimum distances
 - ▶ Redirecting of vent plume



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Ice formation

- Often caused by incorrect pipe slope



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Flue gas recirculation

- ▶ Multiple outlets
- ▶ Swirling winds
- ▶ Building corners



Dealing with the products of combustion

Flue gas recirculation

- ▶ Multiple outlets
- ▶ Swirling winds
- ▶ Building corners



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Flue gas recirculation

- ▶ Damage to internal boiler components:
 - ▶ Venturi inlets
 - ▶ Radial fan bearings, etc.
- ▶ Bad combustion, high CO levels
- ▶ Intermittent burner lockouts



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Damage to façade surface

- ▶ Stucco
- ▶ Masonry
- ▶ Composite siding



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Installation errors

- ▶ Exhaust and air pipes reversed



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Installation errors

- Under a deck!



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Installation errors

- ▶ Too close to ground
- ▶ Too close to windows/doors



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Vertical venting

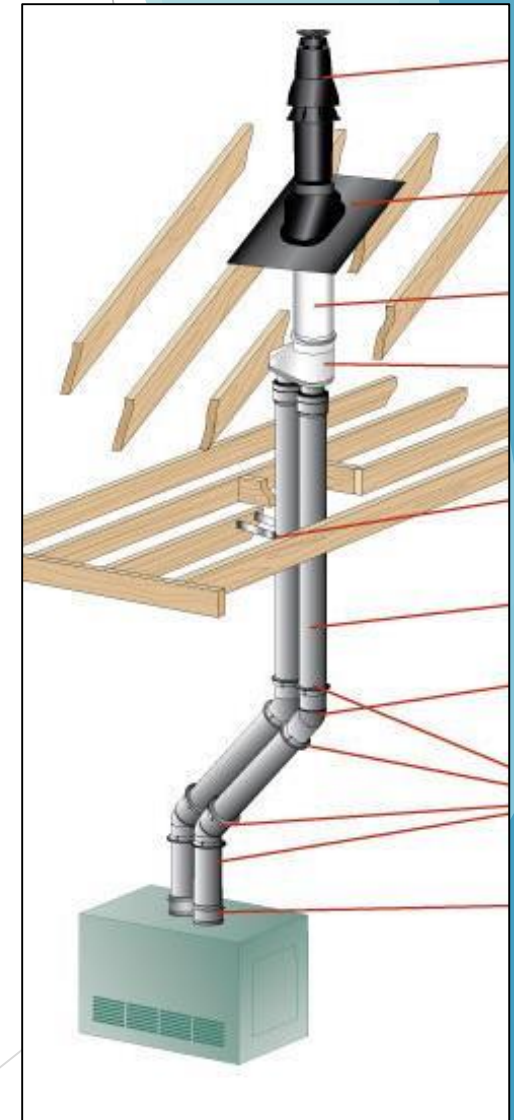
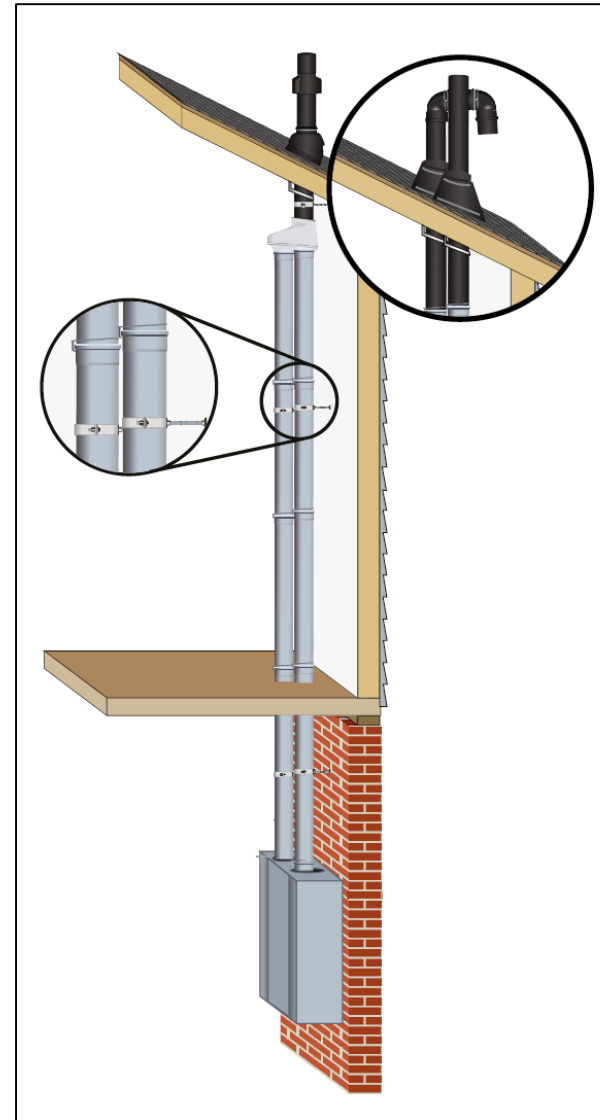
- ▶ The best option!!
- ▶ Flue gases terminated above the roof line are dispersed into the atmosphere well above the level of people, plants and building surfaces
- ▶ The "*peacekeeper*"



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Vertical venting with rigid pipe

- ▶ PVC/CPVC
- ▶ Polypropylene
- ▶ Concentric or two pipe



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Vertical venting with flexible pipe

- ▶ Polypropylene
- ▶ Stainless steel



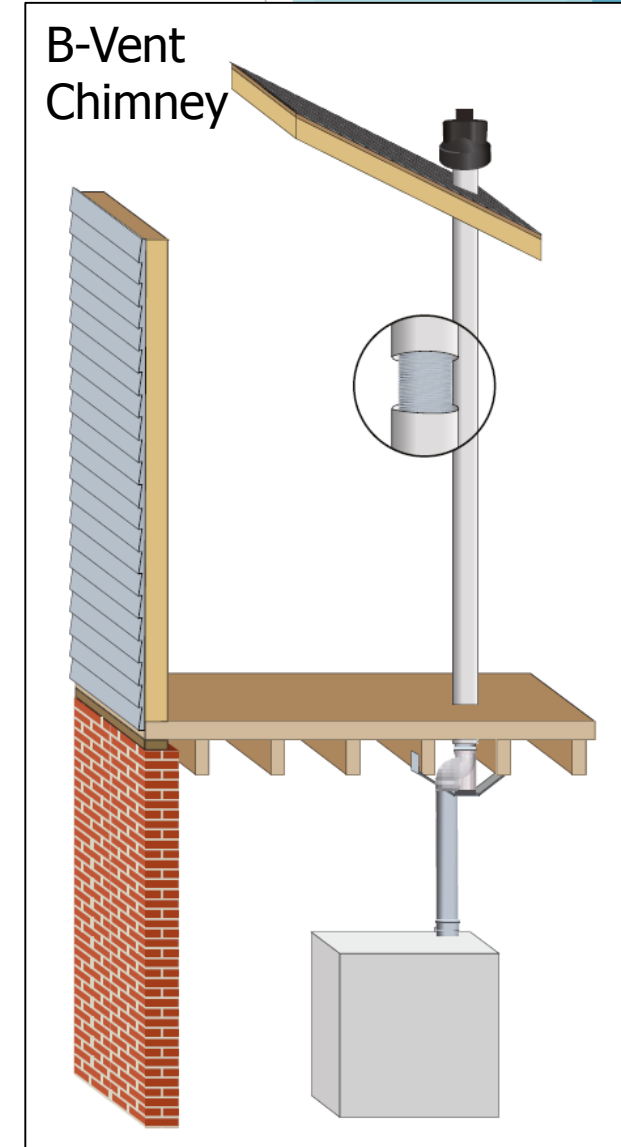
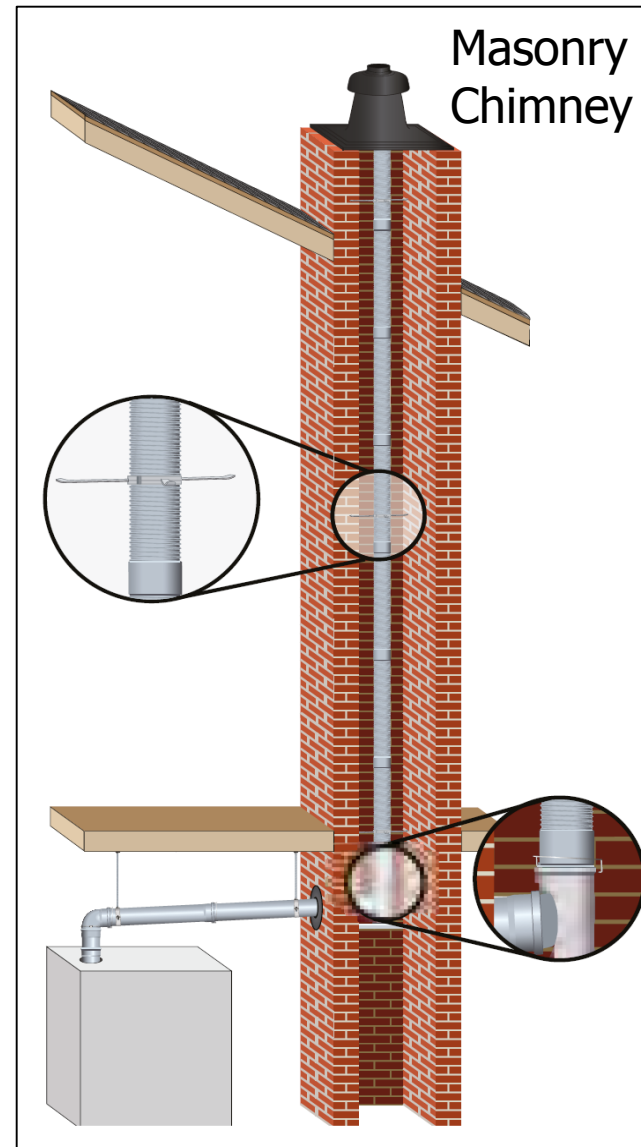
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Vertical venting with flexible pipe

- Up existing masonry or B-vent chimney

"Many contractors are not aware, or do not often consider this method of venting"

Vent pipe manufacturer's sales manager



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Solutions for venting issues

- ▶ Consider vertical venting wherever possible
- ▶ Carefully review venting plan with building owner:
 - ▶ Review vertical and sidewall options
 - ▶ Make them aware of potential issues
- ▶ Look-out for landscaping, driveways, adjacent buildings, etc.
- ▶ Keep the neighbour happy!

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Part 2: Condensate Disposal Options and Challenges

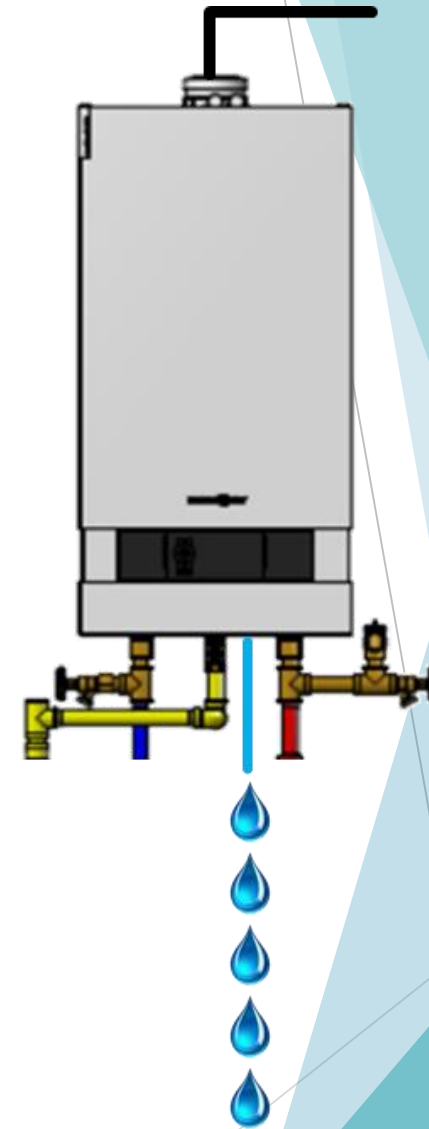
- ▶ **Condensate disposal options:**
- ▶ **Condensate disposal challenges and issues**

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How much condensate is produced?

Rule of thumb flue gas condensate volume:

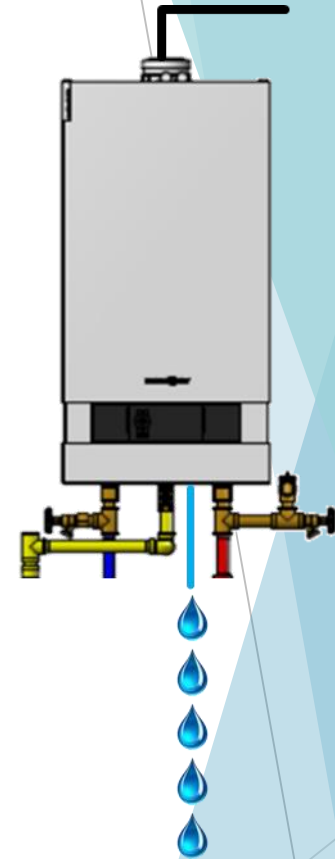
- ▶ When the appliance is operating in fully condensing mode:
 - ▶ 1 gallon per hour of condensate is produced for every 100,000 BTUs of input



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What happens if condensate does not flow away from boiler?

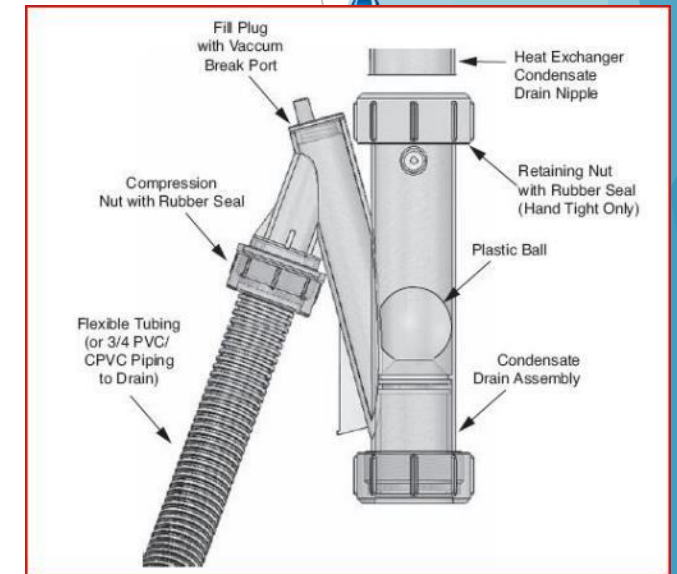
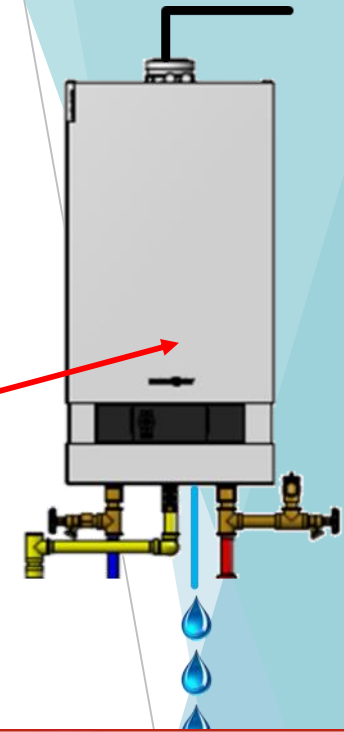
- ▶ Condensate will back up into boiler
- ▶ Water floods combustion chamber
- ▶ Burner locks out.....*NO-HEAT CALL!*
- ▶ Potential for water leakage onto floor
....*WATER DAMAGE!*



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Internal P-trap in boiler

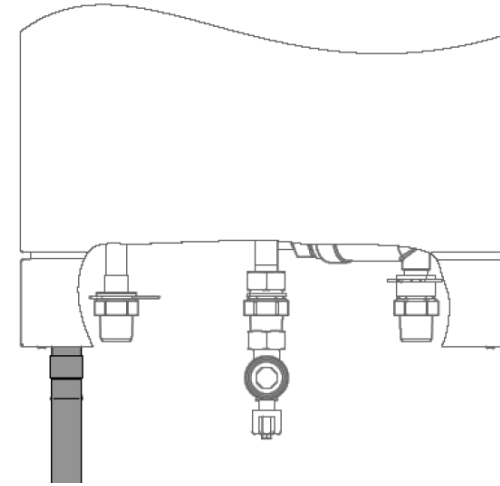
- ▶ Condensing boilers have built-in P-Trap
- ▶ Keeps flue gas from escaping combustion chamber
- ▶ P-trap must be primed on initial installation and after service
- ▶ Clean annually to eliminate blockage



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Condensate disposal

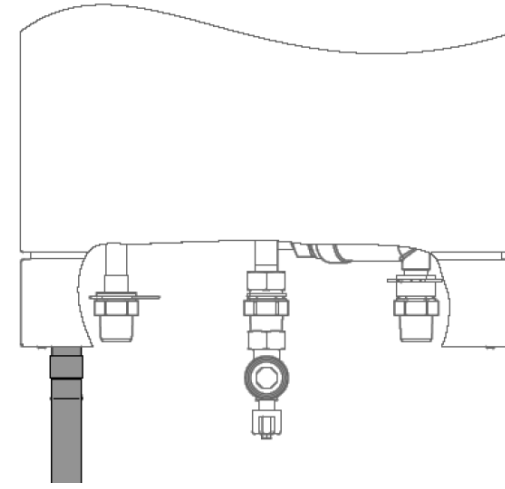
- ▶ Condensate drain pipe must be sized correctly
- ▶ More condensate comes from boiler than AC unit
- ▶ Pipe too small = restricted flow



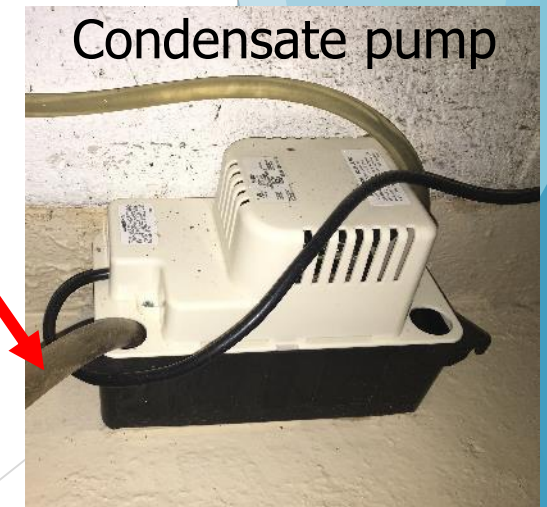
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Condensate disposal

- ▶ Condensate drains by gravity out of boiler
- ▶ Condensate must flow to either a floor drain **or** to a condensate removal pump



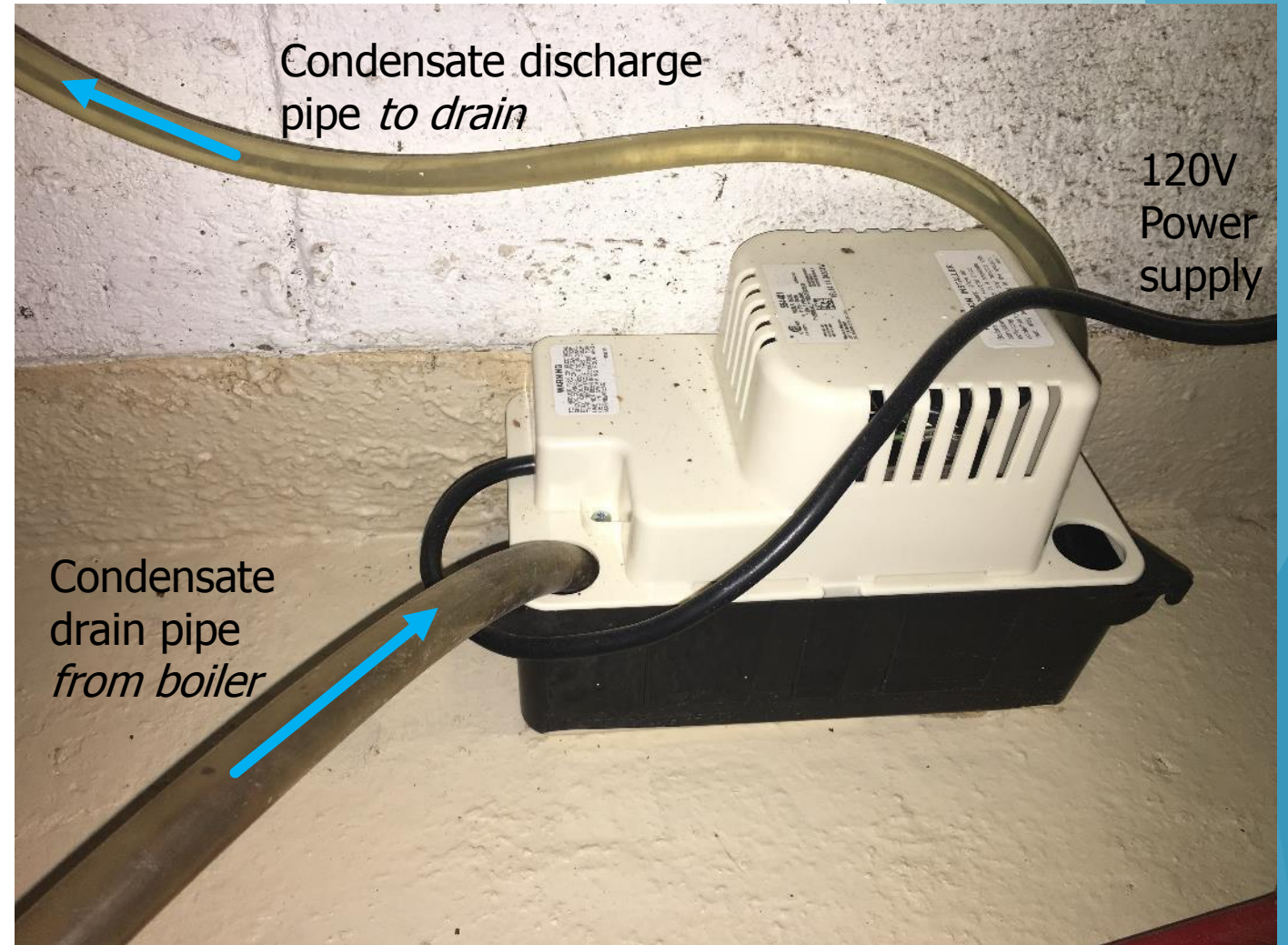
or



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Condensate disposal pump

- Pumps condensate from boiler to another location

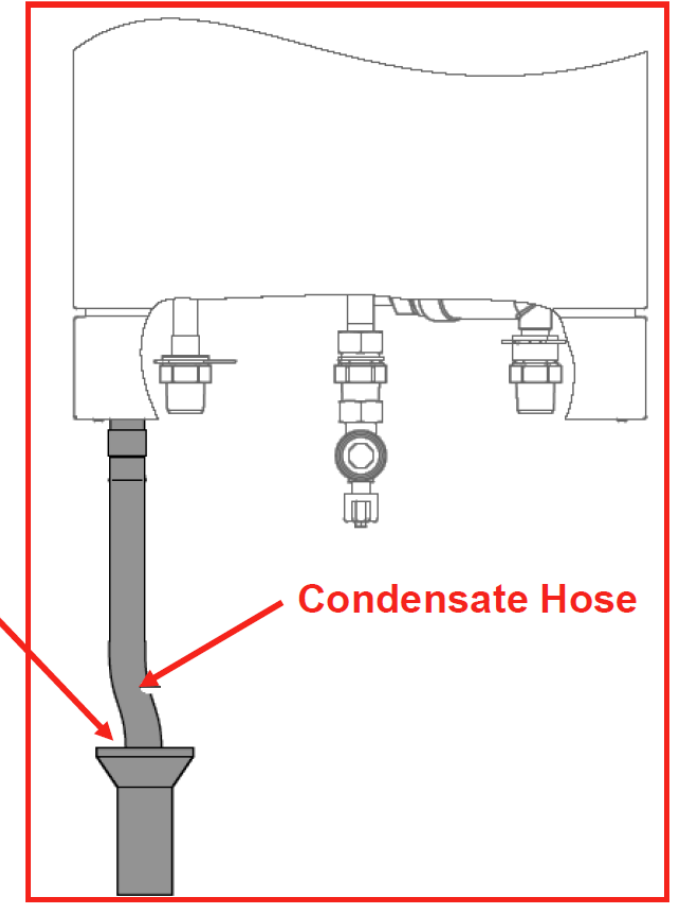


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Atmospheric Vent

- ▶ An atmospheric vent must be provided between the appliance and the drain
- ▶ With no vent a double trap is created which eliminates natural siphoning
- ▶ Always provide an air gap between drainage pipe and condensate disposal system

**Air Gap required,
Do Not pipe rigid
to drain**



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Atmospheric Vent

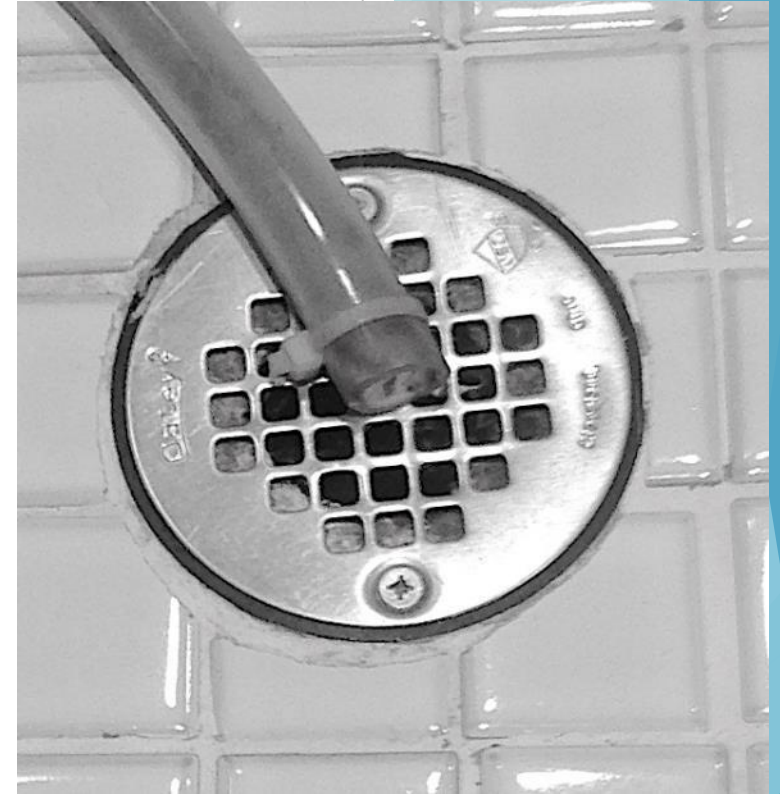
- ▶ Install tee in drain line from boiler
- ▶ Tee is vented to atmosphere



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Atmospheric Vent

- ▶ Do not push pipe down drain
- ▶ Do not push pipe to far into pump
- ▶ Have visual “dripping” of water



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Dealing with corrosive condensate

- ▶ Condensate contains concentrations of nitric, sulfuric, and hydrochloric acids
- ▶ Condensate will damage cast-iron drain covers and cast-iron drain pipe



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Condensate neutralization

- ▶ Neutralizing media raises the pH of the condensate to a safe level before discharging it into the drainage system
- ▶ Media is form of calcium carbonate
- ▶ Media requires annual maintenance to prevent blockage
- ▶ Replace media every 1-2 years



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Condensate neutralization



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Installation issue:

- Using the wrong material for condensate lines



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Installation issue:

- Into the shower drain??



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Installation issue:

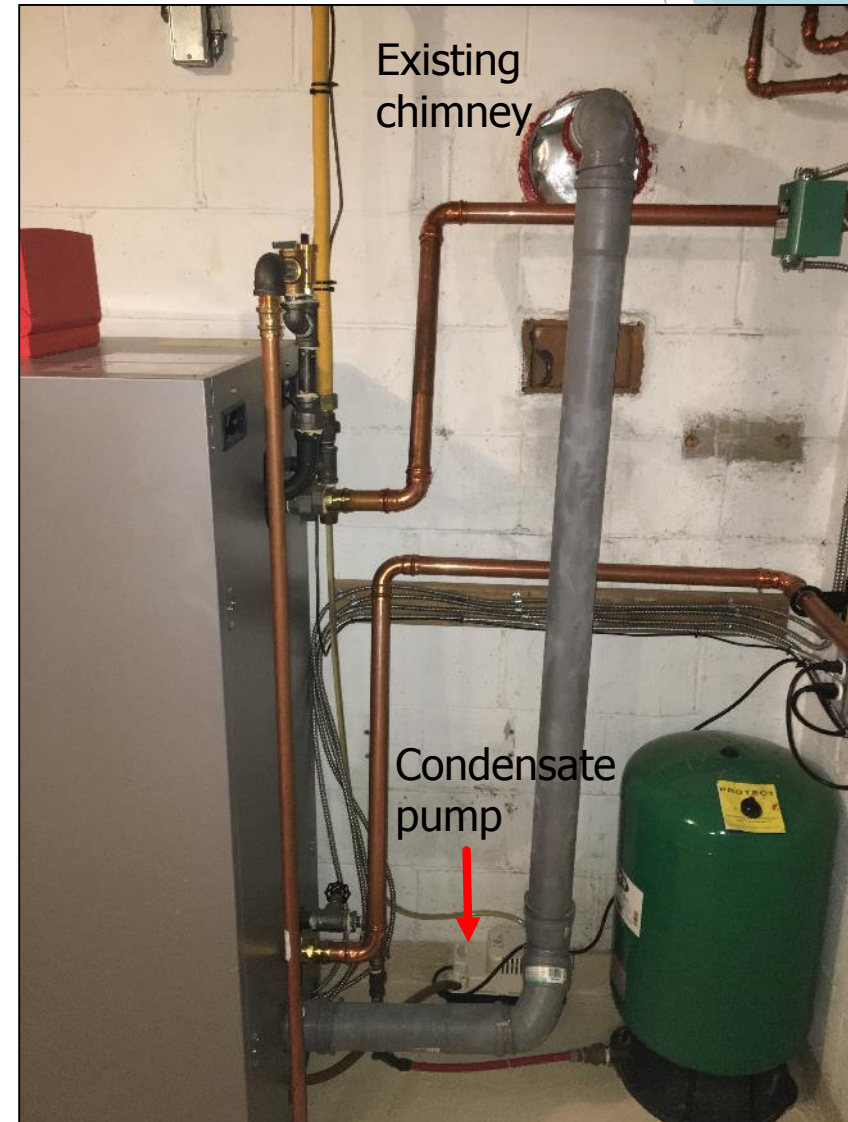
- Clogged neutralizer in need of cleaning



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Modern boiler room upgrade:

- ▶ New condensing boiler
- ▶ Flexible plastic vent pipe up existing chimney
- ▶ Condensate disposal pump



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HPAC Modern Hydronics Summit – 2019

Thank you very much for attending today!

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