Combustion Safety: Data vs. Dogma, and the Evolution of New Standards

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Objectives

- Describe factors that most affect combustion spillage in real homes
- State important and useful testing and inspection methods to assure safety
- Recognize effects that different house setup protocols have on depressurization
- Discuss recent changes in combustion safety test protocols
- Discuss prevalence of combustion spillage as an issue in Weatherization Assistance Program
- Recognize importance of vent system inspection as part of combustion safety evaluation
- Identify the prevalence, causes, and solutions to combustion spillage problems

Agenda

1. Spillage – Stacy Gloss
2. Sound Insulation Study & Combustion Safety - Dave Bohac
3. Combustion Safety Field Study – long term monitoring – Dan Cautley
4. Combustion Safety Field Survey – Stacy Gloss

Survey

- How many have or do actively perform testing?
- How many are familiar with the BPI protocol?
- How many are familiar with or have used the Nat'l Fuel Gas Code?

Covering the basics

- What is spillage?
- What causes spillage?
- Why is spillage important?
- What standard(s) cover combustion safety
- Recent changes to the BPI Building Analyst standard

What is Spillage?

GSL2

GSL1

Normal Vent Flow

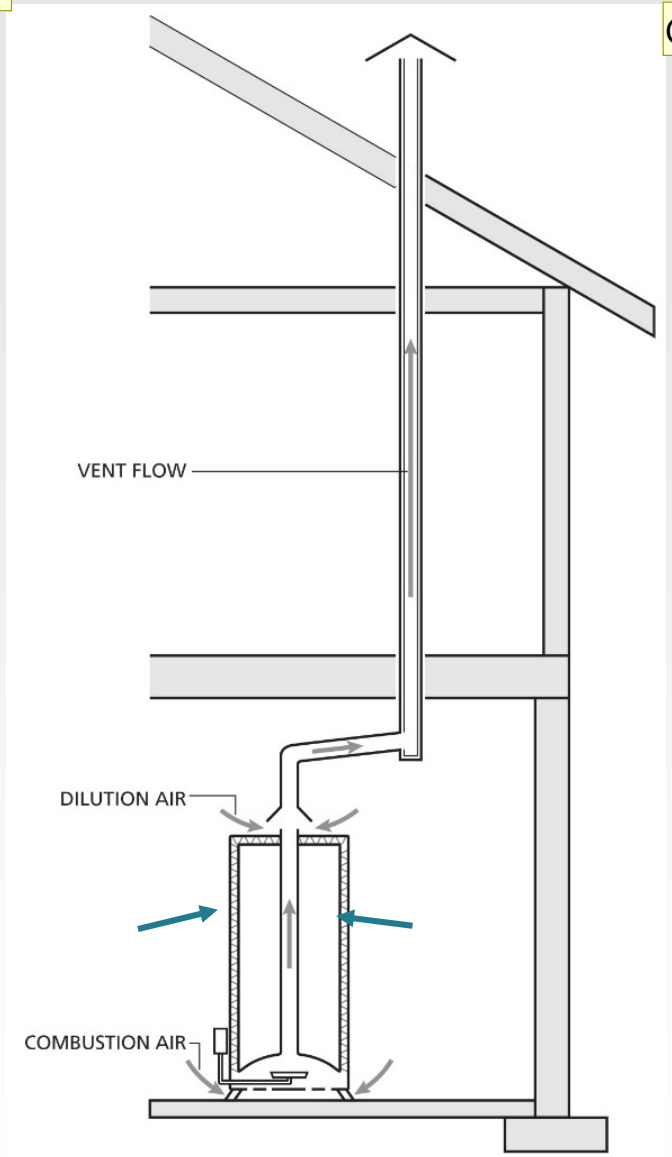


Image courtesy of Seventh Wave

Slide 8

GSL1 Gloss, Stacy L, 2/22/2016

GSL2 Gloss, Stacy L, 2/22/2016

Spillage

Spillage is like trying to move too much water through a culvert, some spills over.

https://schoonoverfarm.wordpress.com/2015/02/08/triple-atmospheric-river-event/

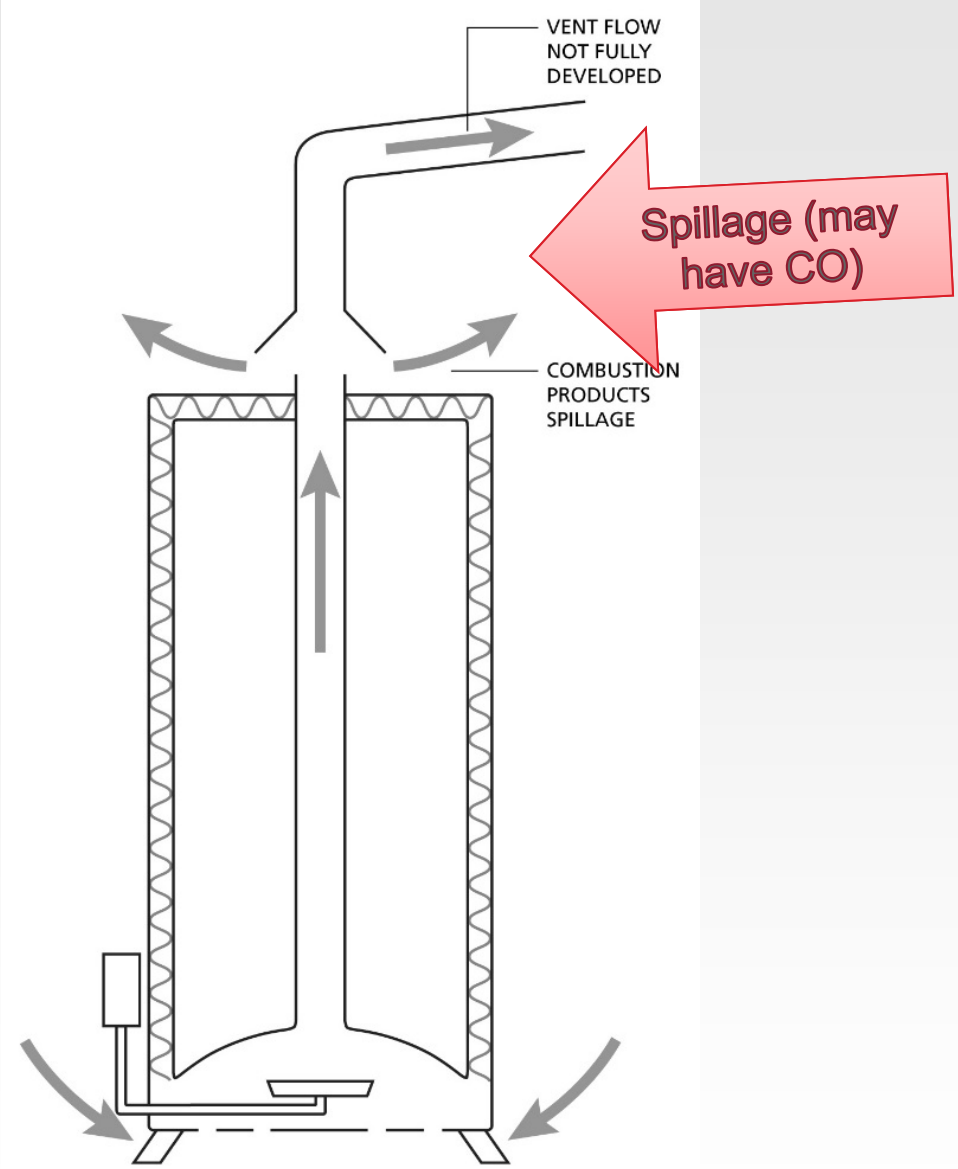


Image courtesy of Seventh Wave

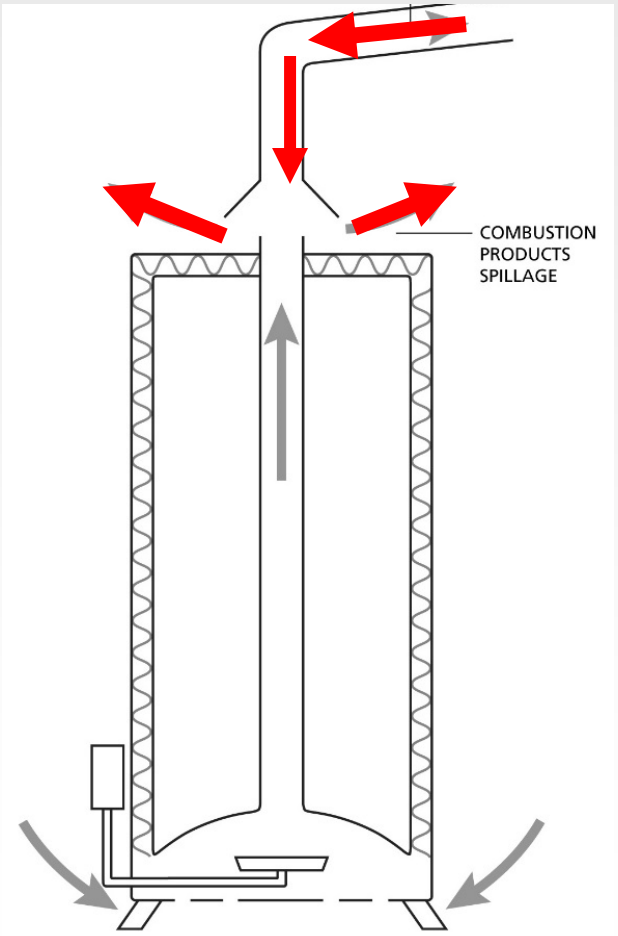
Spillage

Triggered by:

- Start of burner operation
- Venting Defect
- Return duct leakage
- Exhaust fan depressurization
- Air handler operation
- Dryer operation
- Crushed roof cap
- Improper flue sizing

Distinguishing Spillage from Backdrafting

- Backdrafting
  - Flue gas direction is reversed.
  - Gases travel down the flue.



Testing for Spillage

Field Combustion Safety Tests

- The test you did in the past depends on the standards your organization followed: BPI, SWS, ACCA, NFPA
- CAZ Pressure Testing
  - Relied on table
- CO
  - Measured in flue
- Spillage
  - Time limit varied dependent on standard
- Draft Test
  - Relied on table, dependent on outdoor temperature
  - No longer required under BPI-1200-2015

Depressurization limits – BPI 101

Orphan natural draft water heater	-2 Pa
Natural draft boiler or furnace commonly vented with water heater	-3 Pa
Individual natural draft boiler or furnace Induced draft boiler Furnace commonly vented with a water heater	-5 Pa
Power vented or induced draft boiler or furnace alone, or fan assisted DHW alone	-15 Pa

BPI-1200-2015 - Simplified WCD set-up

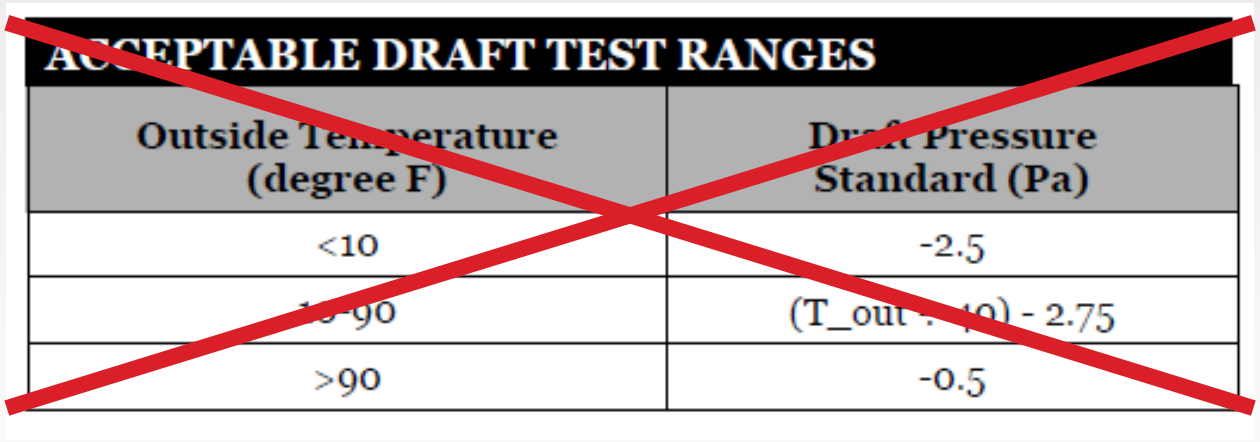
- No longer need to check every door
- Keep doors open if there is a return or exhaust on other side
- Close doors if there is a supply and no return or exhaust

Close door (if no returns or exhausts)

Leave door open

Draft testing – BPI-101

- Depends on temperature



ACCEPTABLE DRAFT TEST RANGES	
Outside Temperature (degree F)	Draft Pressure Standard (Pa)
<10	-2.5
10-90	(T_out - 10) - 2.75
>90	-0.5

BPI Gold Sheet

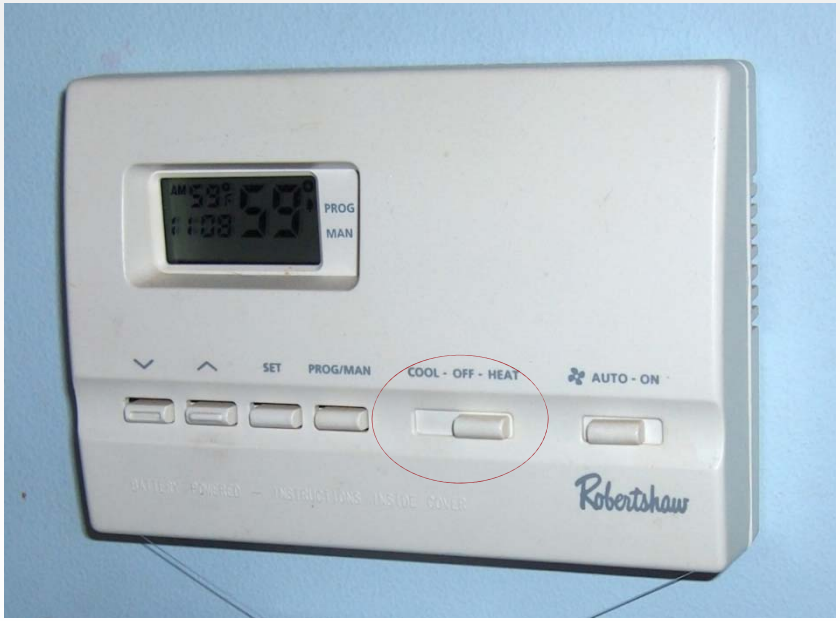
Spillage – what we used to do

- With BPI, you would check for spillage after 1 minute. If spillage after 1 min it failed.

- Organizations had different standards on this. You might see 1, 2, 3, or 5 minutes.

Spillage in BPI-1200

- 2 minutes for water heaters any time of year(could always be warm) and furnaces in heating mode (check t-stat).
- 5 minutes for furnaces not in heating mode



Spillage & Appliance Start Up

- Some spillage can be expected on start-up.
- However, soon after start-up spillage should stop.
- Typically not enough to cause significant increases in household CO.
- When spillage does continue, CO levels can begin to increase.
- Spillage measurement time depends on warm vent (2 min.)/ cold vent (5 min.).

Appliance CO testing

- All organizations adopting industry table, MOSTLY air-free
  - **Measure at 5 minutes**

Table 1 CO Thresholds for Fossil-Fuel Fired Combustion Appliances	
Appliance	**Threshold Limit**
Central Furnace (all categories)	400 ppm air free
Boiler	400 ppm air free
Floor Furnace	400 ppm air free
Gravity Furnace	400 ppm air free
Wall Furnace (BIV)	200 ppm air free
Wall Furnace (Direct Vent)	400 ppm air free
Vented Room Heater	200 ppm air free
Unvented Room Heater	200 ppm air free
Water Heater	200 ppm air free
Oven/Broiler	225 ppm as measured
Clothes Dryer	400 ppm air free
Refrigerator	25 ppm as measured
Gas Log (gas fireplace)	25 ppm as measured in vent
Gas Log (installed in wood burning fireplace)	400 ppm air free in firebox

Worker Safety around CO in BPI-1200

- Test in Ambient – several stages
  - 9-35 ppm: look for the source, advise resident, can continue
  - 36-69 ppm: recommend shutting off all combustion appliances, ventilate, advise resident
  - 70+: cease inspection, evacuate, notify emergency services

What was presented so far.

- What is spillage?
- What causes spillage?
- Why is spillage important?
- Recent changes to the BPI Building Analyst standard

Combustion Safety Field Study: Survey Results

Stacy Gloss
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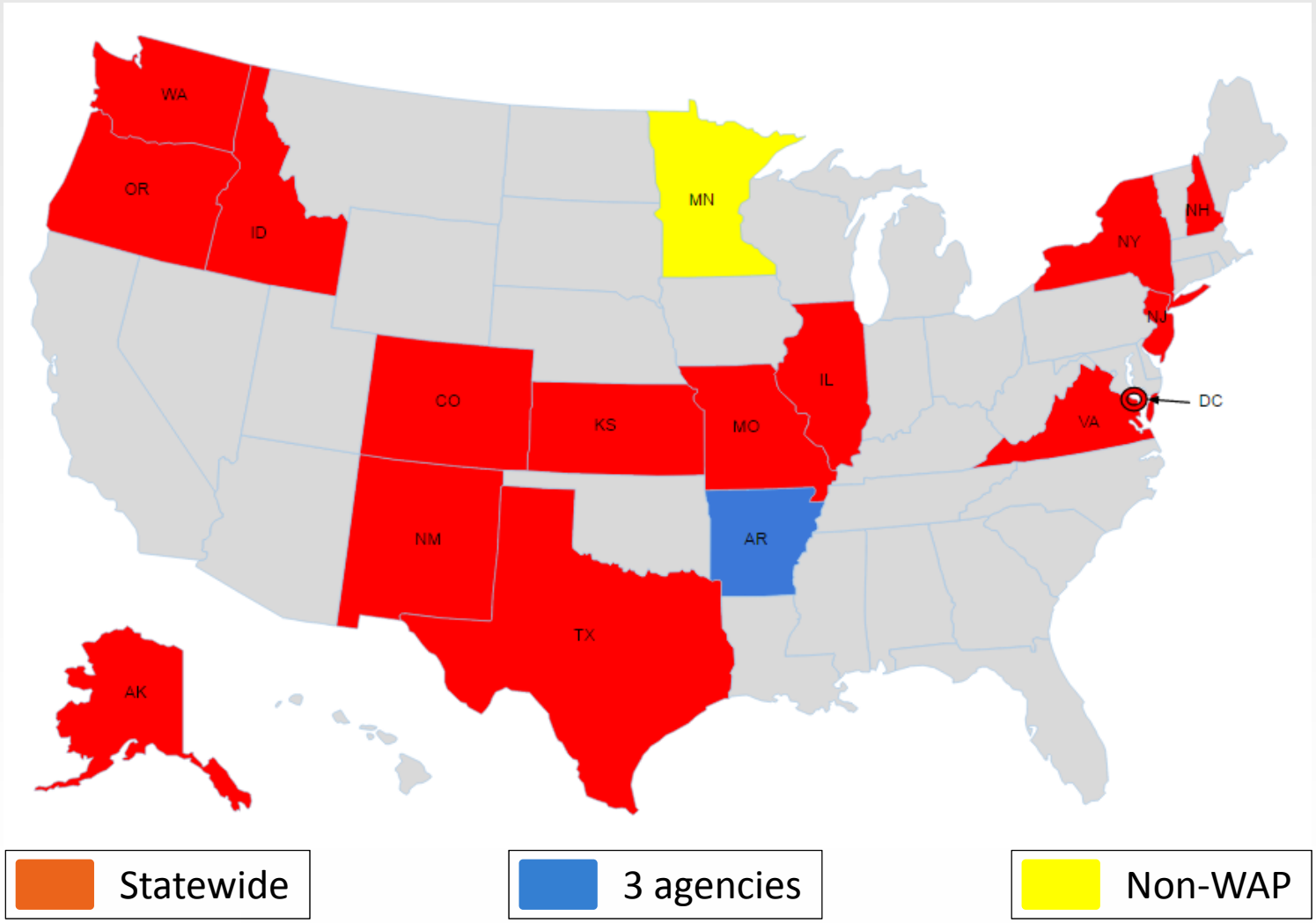
Who Responded?



Survey Results – Failure Causes

- Some states volunteered that many/most failures due to:
  - Improper flue sizing
  - Crushed roof cap
  - Air handler operation
  - Dryer operation

Survey Conclusions

- Combustion safety failures not as common as expected
- Combustion safety failures not often due to exhaust fans
  - Usually air handlers or dryers or vent failures
- Very little actual tracking of this information (great opportunity?)

For Additional Follow-Up

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