

Benefits of Modern-Day Combustion Safety Testing: Realtime vs Steady State

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Preview

- Safety first
- Importance of modern-day tools
- Steady state + Real time
- Missed combustion safety
- Next steps



Personal CO “Safety First”



- Your safety comes first
- All spaces monitored for CO
- Space testing only guarantees your immediate safety
- Personal CO alarms are mandatory

Test with Analyzers all the time, not just when YOU want.

Combustion Analysis

- As-Measured CO (pattern and level)
- Oxygen (pattern and level)
- Flue temperature
- Draft

When should you measure

- Maintenance
- Commissioning
- Comfort complaints
- No heat calls after repairs.
- Sales calls
- Reports of sickness

Here's Why

Safety

Liability

Missed opportunity

Efficiency

Comfort

Happy customers

Increase in revenue

Health

Reduced warranty

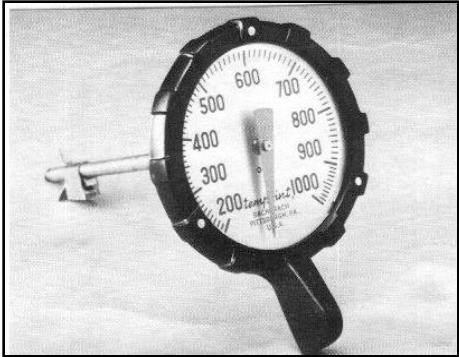
9 Reasons To Test Combustion

Evolution of Combustion Test Instruments

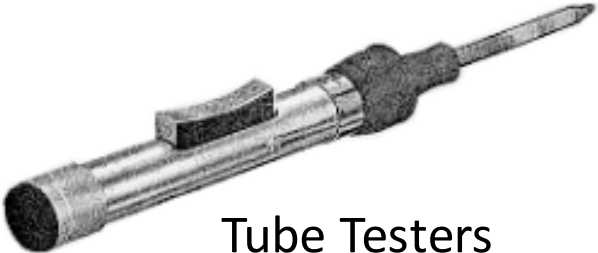
Early:



Fyrite Bottles



Thermometers



Tube Testers



Digital Analyzers

Si-CA 030 Combustion Analyzer

Residential and Light Commercial analyzer

- Up to **Three Gas Sensors**
- **O₂, CO, and NO** (for NOx)
- **CO Sensor** measures up to **8000 ppm**
- Auto pump **Cut-Off** for **High CO** levels
- Quick & easy **Pump On/Off** control
- **Color Display** screen

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DATA SHEET

Si-CA 030

Residential & commercial combustion analyser
The latest in combustion analysis technology
Compact, Light and Durable Design

- Up to three gas sensors O₂, CO, and NO (for NOx)
- Color display screen
- Lightweight, only 350 g (12 oz)
- Auto pump cut-off for high CO levels
- CO sensor measurement up to 8,000 ppm
- Data management with automatic logging & report creation

Download on the **Google Play** and **App Store**. **FREE APP**

- Predictive maintenance with estimated sensor life & calibration reminders
- Draft & differential pressure measurements
- Calculated CO₂ % value
- NOx capable with NO sensor
- Quick and easy pump On/Off control
- Combustion efficiency & excess air calculations
- CO safety monitoring in ambient air
- Protective rubber holster
- Maintenance contracts and extended warranties available

Dimensions: 43 mm (1.67") x 58 mm (2.28") x 18 mm (0.71")

Compact design:

LongLife Plug and Air Catch Plug logos are trademarks of Google LLC. All rights reserved. © 2021 Sauermann.



Si-CA 130 Combustion Analyzer

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DATA SHEET

Si-CA 130

Residential & commercial combustion analyzer
The latest in combustion analysis technology
Compact, Light and Durable Design

- Up to three gas sensors O₂, CO, and NO or Low NO (for NO_x)
- Large color touch screen
- Lightweight, only 250 g (12 oz)
- Field replaceable pre-calibrated sensors
- CO sensor measurement up to 8000 ppm
- Data management with automatic logging & report creation through app/PC software

- Predictive maintenance with estimated sensor life & calibration reminders
- Draft & differential pressure measurements
- Calculated CO₂ value
- Auto pump cut-off for high CO levels (user-adjustable)
- NO_x capable with NO sensor (optional)
- One Touch Pump On/Off with Purge
- PC software with wireless and USB connectivity
- Combustion efficiency & excess air calculations
- Graphical data display
- Customizable gas analysis screen
- Sample conditioning unit for low NO_x & high moisture applications
- CO & CO₂ Monitoring In Ambient Air
- Smart Air Temperature Probe
- Protective rubber holster
- Maintenance contracts and extended warranties available

Dimensions

Compact design

Download on the App Store

GET IT ON Google Play

Residential and Commercial analyzer

- Up to **Three Gas Sensors**
- **O₂, CO, and NO or Low NO (for NO_x)**
- Large color **touch screen** with zoom & graphical view
- **Field Replaceable** pre-calibrated gas sensors
- **CO Sensor** measures up to **8000 ppm**
- **Data management with automatic logging and report creation**



Si-CA 230 Combustion Analyzer

Industrial, Commercial and Residential Analyzer



- Up to **Six** Gas Sensors
 - **O₂, CO, NO, Low NO, NO₂, Low NO₂, SO₂, Low SO₂, H₂S, & CxHy**
- **CO Dilution** auto-range with measurements to **50,000 ppm**
- **iOS and Android Mobile Apps** for **real-time display & control**
- Large color **touch** Screen with zoom & graphing
- **Field Replaceable** pre-calibrated gas sensors
- **Superior Hose Material** will not affect **NO₂, SO₂, and H₂S** measurements

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DATA SHEET

Si-CA 230

Gas Analyzer for Emissions Monitoring of Boiler, Engine, & Other Combustion Applications

Accurate / Reliable / Robust / Innovative

- Up to Six Gas Sensors. Can include O₂, CO, NO, Low NO, NO₂, Low NO₂, SO₂, Low SO₂, H₂S, and CxHy
- CO Dilution auto-range with measurements to 50,000 ppm
- Large Color Touch Screen
- Total NOx & Low NOx Capable
- iOS and Android Mobile Apps for Real-Time Display & Control
- Field Replaceable Pre-Calibrated Sensors

Key Features:

- Ergonomic, light weight, & durable design
- Data management with automatic logging & report creation
- Predictive maintenance with estimated sensor life & calibration reminders
- One touch pump On/Off with purge
- PC software with wireless and USB connectivity
- Auto pump cut off for high CO levels
- Graphical data display
- Customizable gas analysis screen
- Sample conditioning unit for low NOx & high moisture applications
- Stack gas velocity with Pitot tube
- Draft & differential pressure measurements
- Emissions values adjusted for reference O₂
- CO & CO₂ Monitoring in Ambient Air
- Flow restrictors for tall & difficult to reach stacks
- Wireless Printer
- Protective rubber holster
- Maintenance contracts and extended warranties available

Apps and software

- Free apps for iOS & Android mobile devices
- PC software with USB & wireless connectivity
- Fast, easy wireless connection
- Remote live view of combustion analysis data as list or graph
- Remote control to change settings
- Data saving, including automatic logging
- Report creation in PDF, CSV (for Excel) and XLS formats
- Databases for customers, operators, & equipment

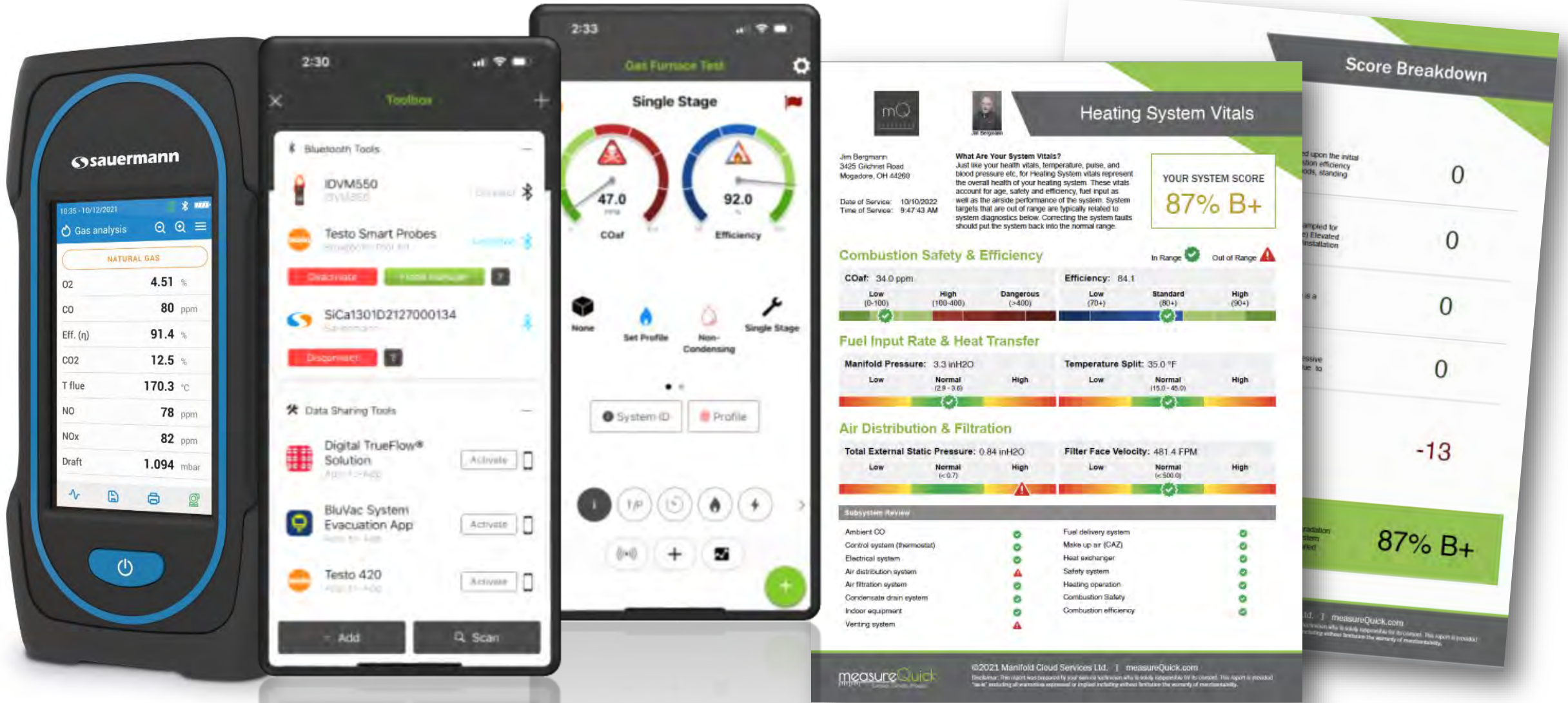
Download app

Graph View

Data View



Sauermann has partnered with measureQuick!!



Kits for Each Analyzer

Si-CA 030 → Kits consist of gas sensors (2 or 3 with NO), probe (180mm or 300mm), and case (Cardboard Box, Soft Vinyl Case, or hard ABS plastic case).

*Option for daughter board needed for CO/CO2 probes.

Si-CA 130 → Kits consist of gas sensors (2 or 3 with NO or Low NO as 3rd one), probe (180mm or 300mm), and case (soft vinyl case or hard ABS plastic case). *Option for high accuracy draft sensor.

Si-CA 230 → Kits determined by number of gas sensors (from 2 up to 6) and which gas sensors (O2, CO, NO, Low NO, NO2, Low NO2, SO2, Low SO2, CxHy/HC, & H2S). All kits include 300mm probe & hard ABS plastic case. *Option for high accuracy draft sensor.

Many optional accessories (printer, longer probes, hose extension, etc.) available for all analyzers & kits



Steady State Efficiency:

The calculated efficiency of fuel burning equipment operating at **full input** and at **full load** conditions in a fixed environment (lab conditions)

The efficiency of a piece of equipment after **10 minutes** of field operating time **regardless of input or load.**

- Smoke test on natural draft (within the first 60 sec) a mirror can be used to.
- Allow the unit to run for 10 minutes let flue temperatures stabilize
- 10 to 15 minutes grab a carbon monoxide Reading

What's the difference between 99 ppm and 150 ppm or 5 ppm to 50 ppm

Three Stages of Combustion Diagnostics

Light-Off – CO only (First 60 seconds of burner operation).

Run Cycle – Three CO and O₂ readings within a minimum of five minutes (or longer if needed) of operation. Flue temperature and draft are recorded with your third set of readings.

Shut-Down – CO only (60 seconds after burner operation ends).

4 Diagnostics missed by testing under steady state.

Light off –

- Shows up as a rise in Carbon monoxide and peaks out then falls.

Venting Issues –

- Shows up as **rising carbon monoxide** and **falling oxygen** with **high draft**.

Combustion Air –

- Issues show up as **rising carbon monoxide** and **falling oxygen** with **no draft** .

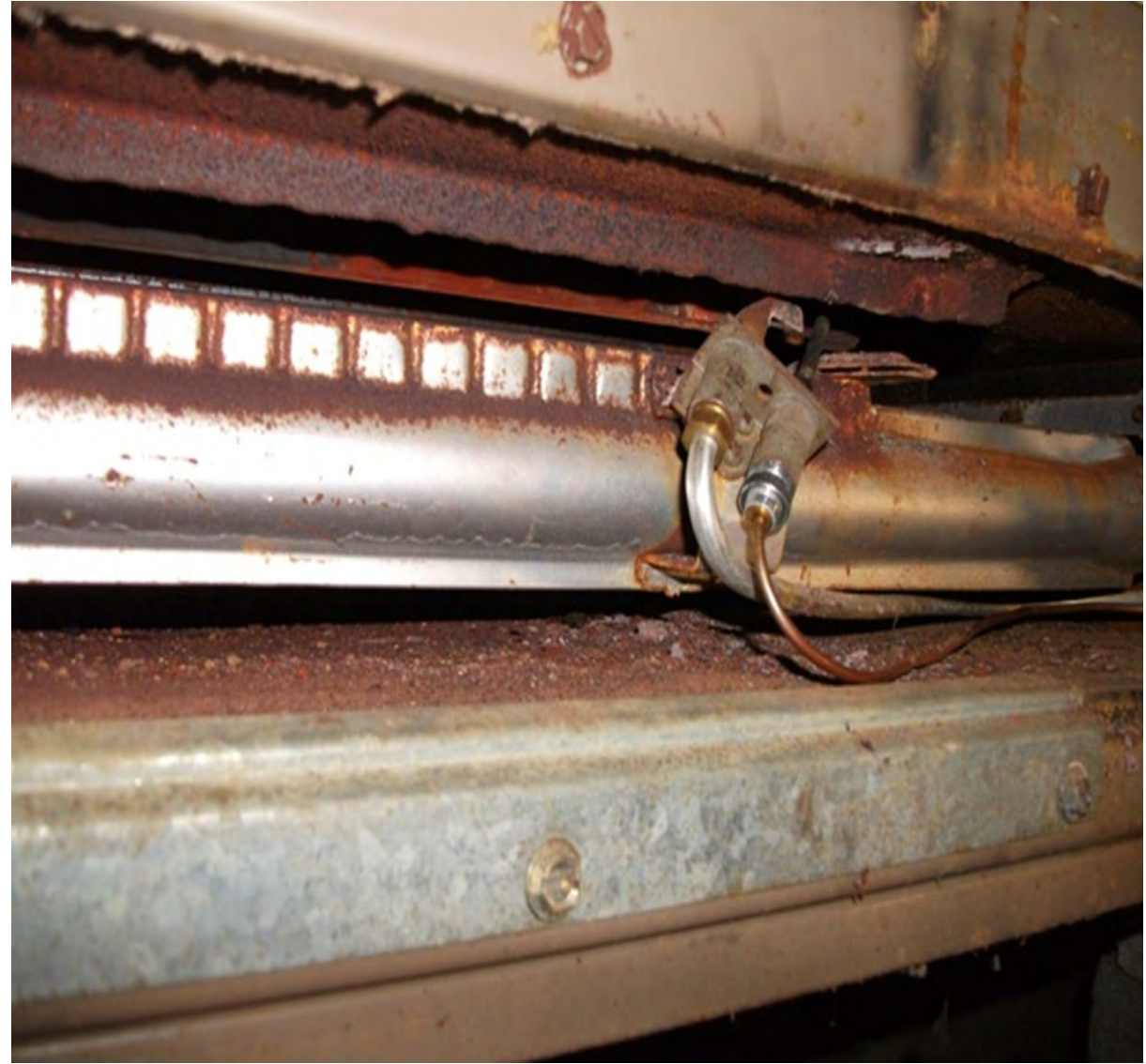
Bad Gas Valves –

- Shows up as **rising carbon monoxide** after the flame goes out.

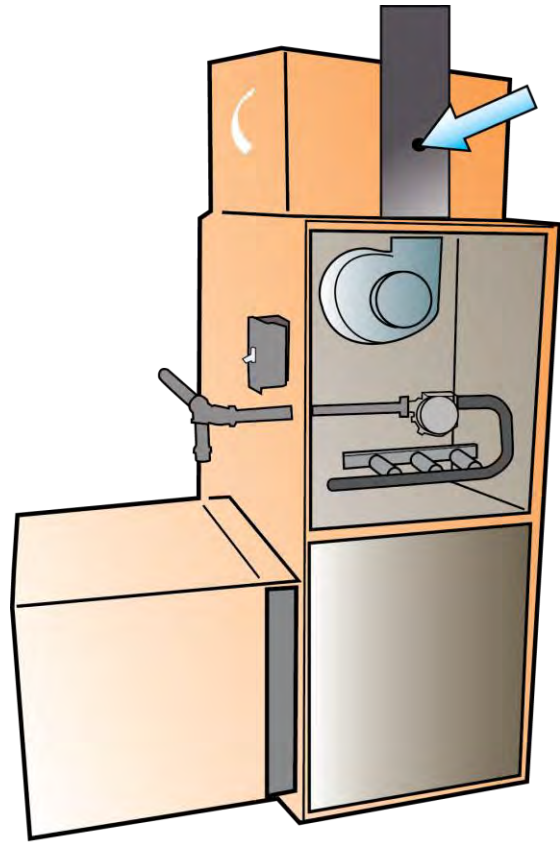
Steady State + Real Time

- Measure every cycle watch it for 10 min
- Get your steady state measurements + safety problems

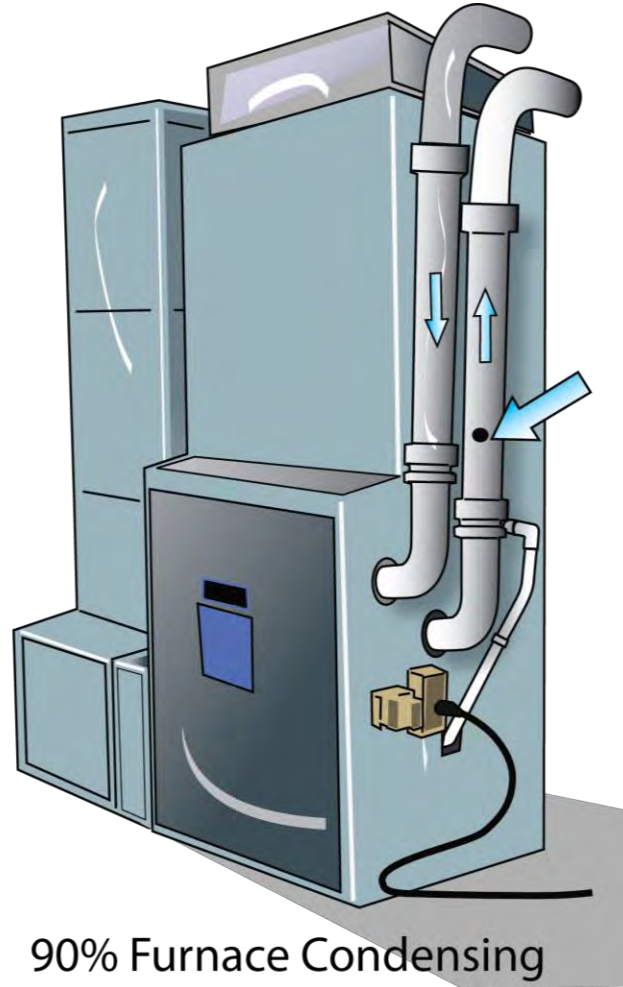
	1 sec	10 sec	20 sec	30 sec	40 sec	50 sec	60 sec	
Light –off	0	50	100	1000	2000	900	100	
CO-Run Cycle								10 min
O2-Run Cycle								95
Flue Temp								5.2%
Draft Pressure								375°
Shut Down								-0.05"
	95	94	97	99	100	130	140	



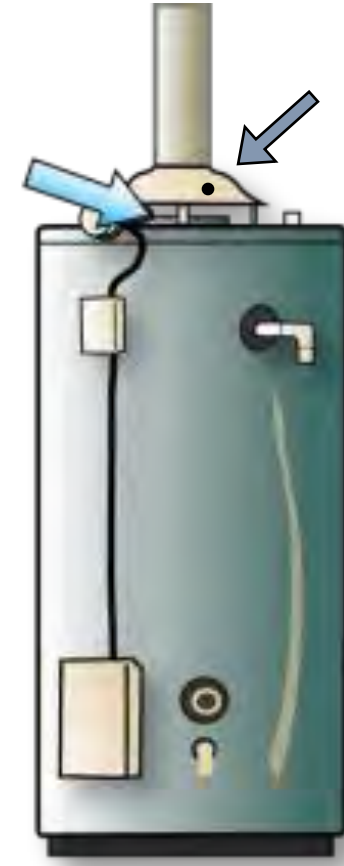
All testing is done in the flue with an analyzer.



80% Induced Furnace



90% Furnace Condensing



Water
Heater

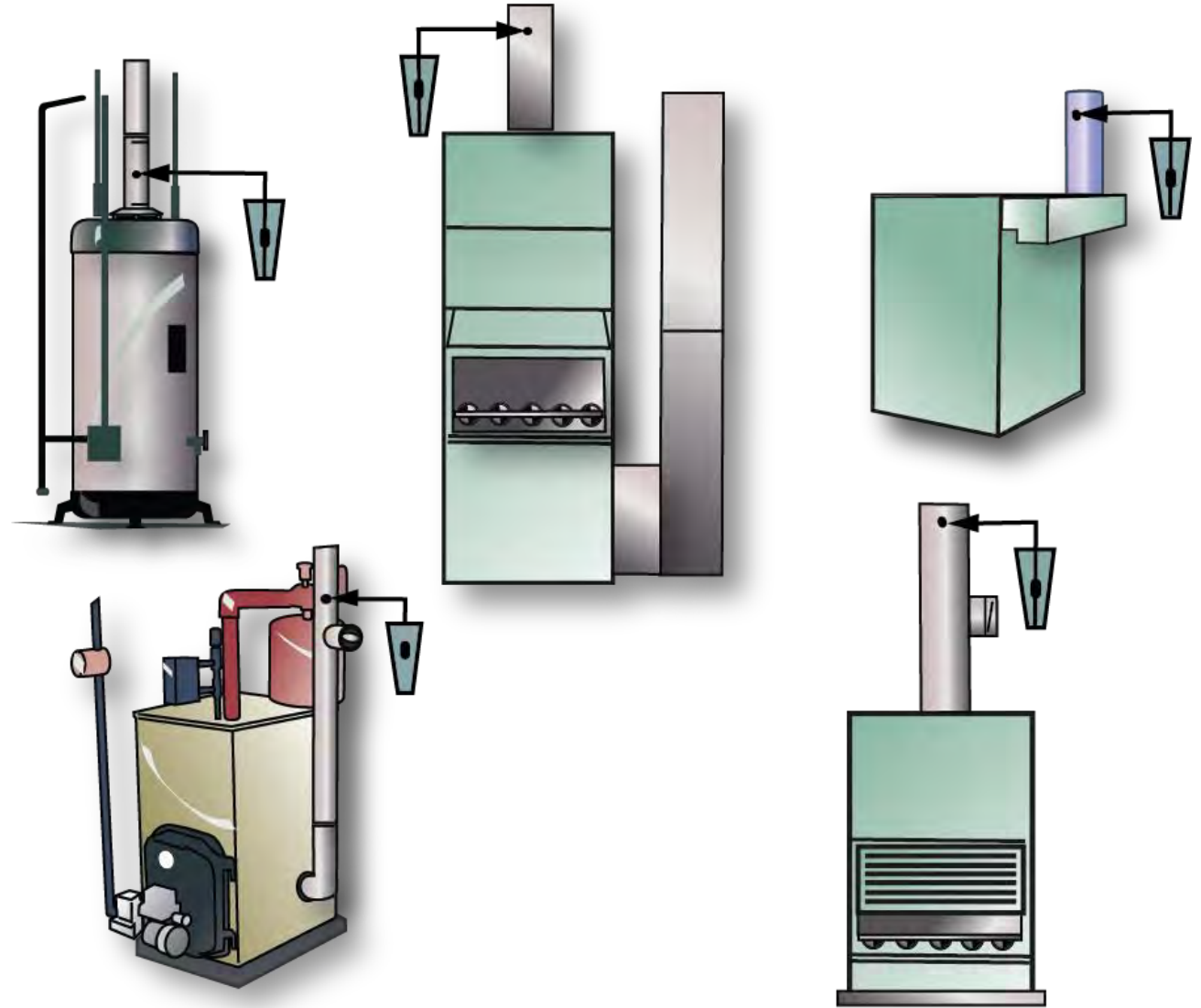
Draft Test Locations

Draft gauge should be inserted above draft hood or diverter.

Test ports should be drilled 18"-24" above appliance so gauge hangs unobstructed.

Design draft is between -0.01" w.c. and -0.02" w.c.

Condensing furnaces do not require a draft test.



Light-Off

Natural Draft Equipment (Draft hood):

CO should not exceed 400 ppm in the first 60 seconds of burner operation.

Light-Off:	0 sec	10 secs	20 secs	30 secs	40 secs	50 secs	60 secs
CO	0 ppm	10 ppm	100 ppm	400 ppm	600 ppm	300 ppm	100 ppm

Light-Off

Induced Draft Equipment (80% and 90%):

CO should not exceed 1000 ppm in the first 60 seconds of burner operation.

Light-Off:	0 sec	10 secs	20 secs	30 secs	40 secs	50 secs	60 secs
CO	0 ppm	30 ppm	200 ppm	800 ppm	1200 ppm	600 ppm	200 ppm

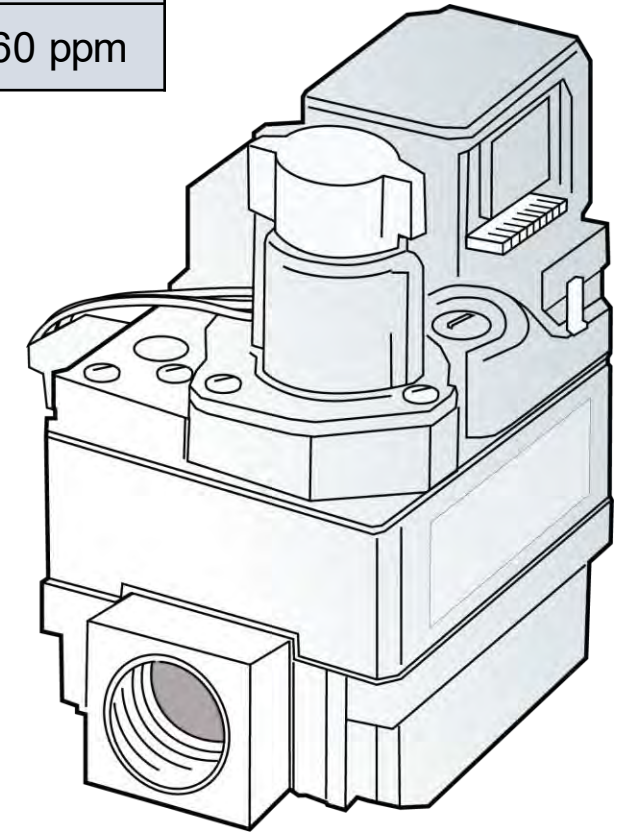
Problems indicated by excessive CO during the first 60 seconds of burner operating.

Light-Off indicates how quickly and effectively all burners ignite

Shutdown Problems

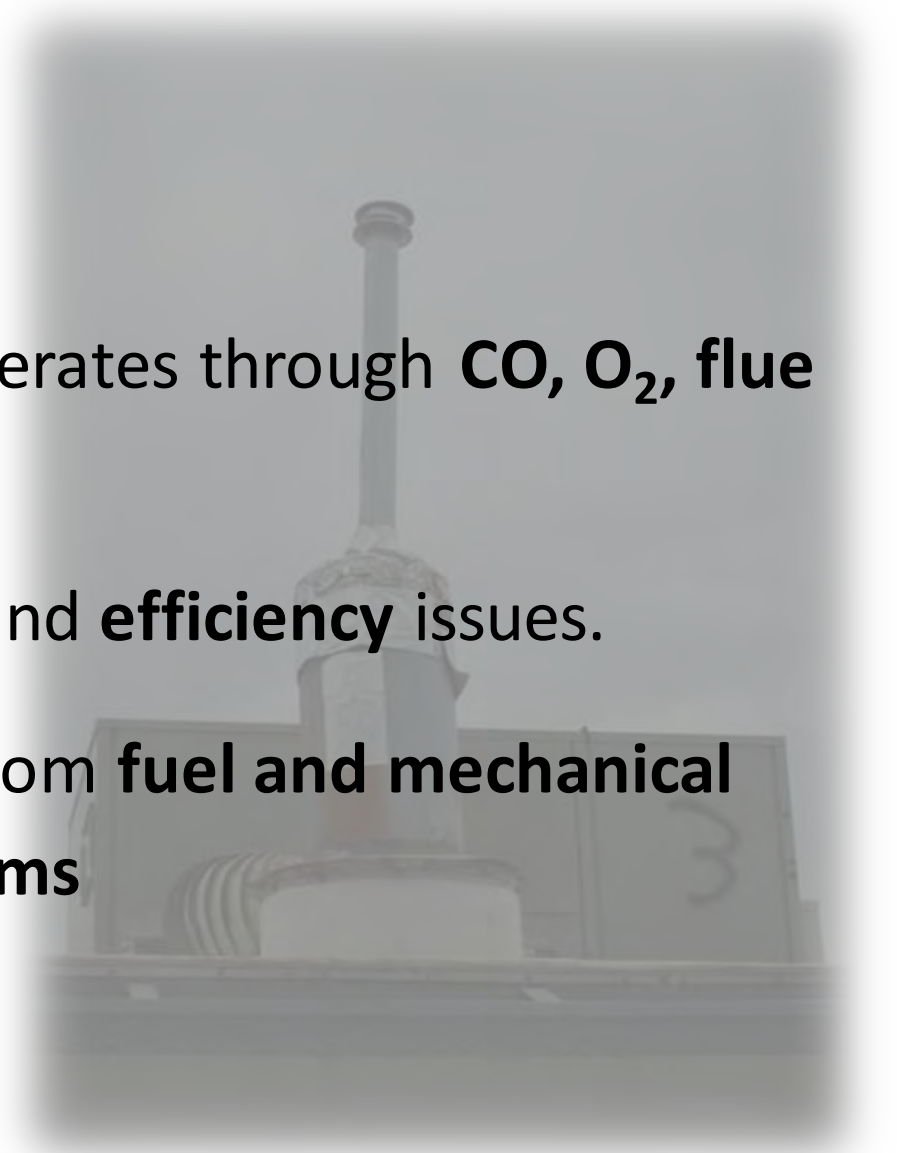
Shut-down:	0 sec	10 secs	20 secs	30 secs	40 secs	50 secs	60 secs
CO	30 ppm	30 ppm	40 ppm	60 ppm	80 ppm	100 ppm	60 ppm

When the call for heat is satisfied and the flames goes out there should be a **fall** in the **CO** reading, from time to time you will find **CO rising**. The **rising CO at shutdown** is an indicator for how poor that fuel valve is closing.



Run Cycle

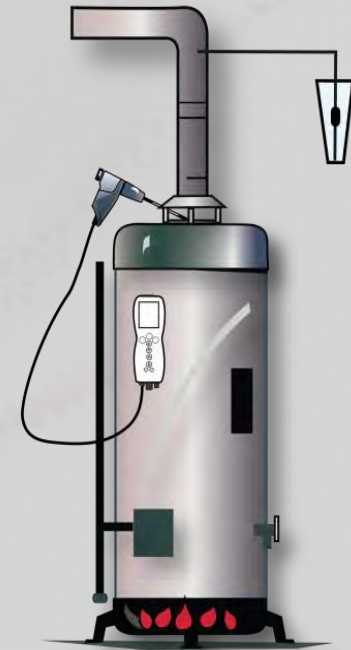
- Problems are identified as the equipment operates through **CO, O₂, flue temperature, and draft** measurements.
- Readings help determine equipment **safety** and **efficiency** issues.
- There are **eight potential issues** that range from **fuel and mechanical issues to venting and combustion air problems**

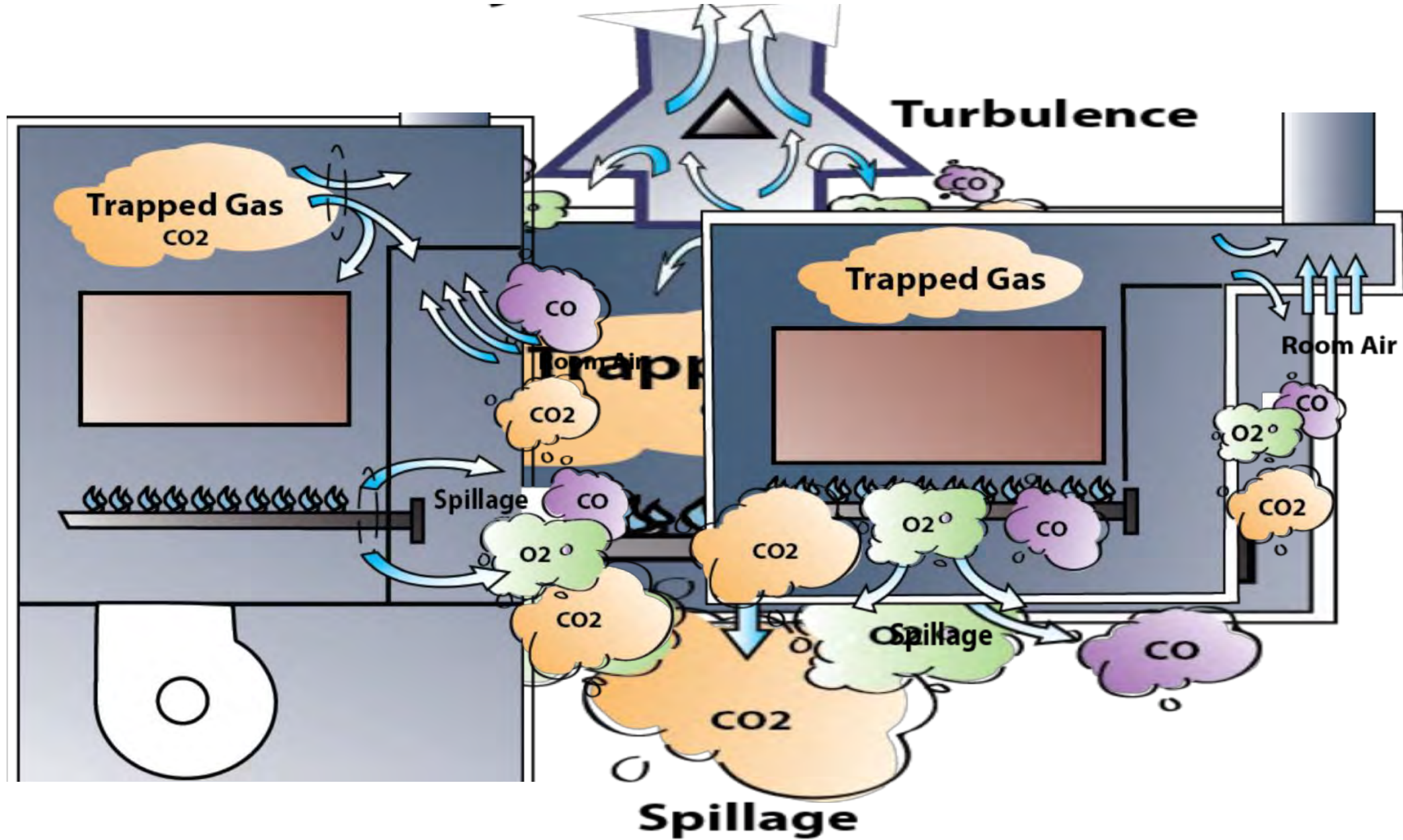


Venting (Draffhood Equipment):

Definition – 100% of the flue gas is not leaving the equipment even though venting system is properly sized and in good condition.

<u>CO-Run Cycle:</u>	1 min	2 min	3 min	4 min	5 min
	10	5	6	7	9
<u>O2-Run Cycle:</u>	10.8%	10.7%	10.6%	10.5%	10.4%
<u>Flue Temp:</u>					250°
<u>Draft:</u>					- 0.04"



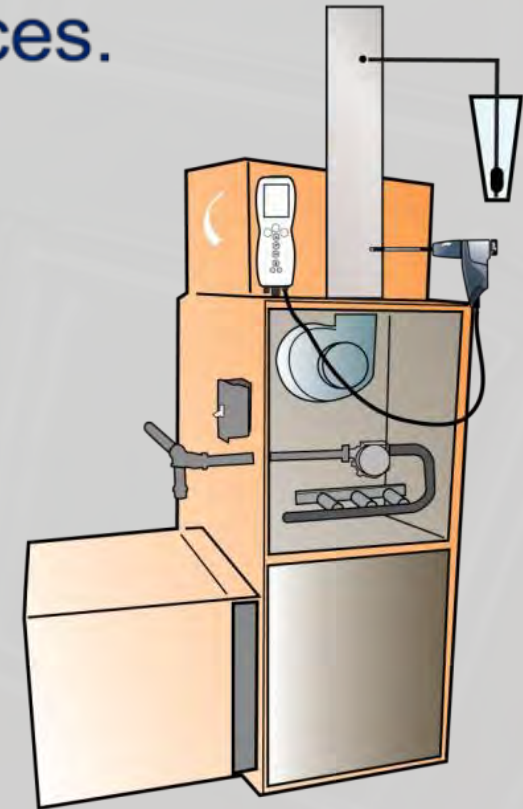


Run Cycle

Combustion Air (Draffhood & Induced Draft 80% Equipment):

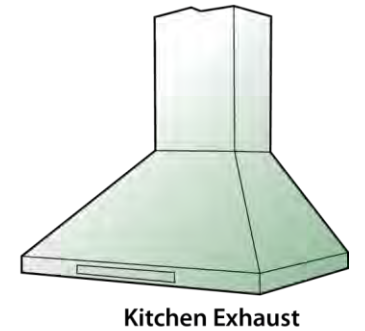
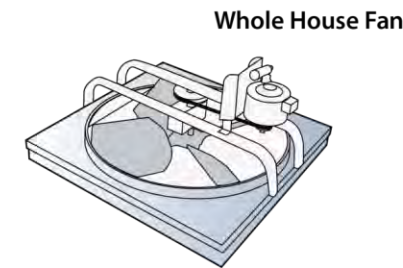
Definition – Adequate room air is available for combustion but misdirected from burners due to external influences.

<u>CO Run Cycle:</u>	1 min	2 min	3 min	4 min	5 min
	50	10	11	12	13
<u>O2-Run Cycle:</u>	7.4%	7.3%	7.2%	7.1%	7.0%
<u>Flue Temp:</u>					360°
<u>Draft:</u>					-0.01"
<u>Plenum Temp:</u>					135°



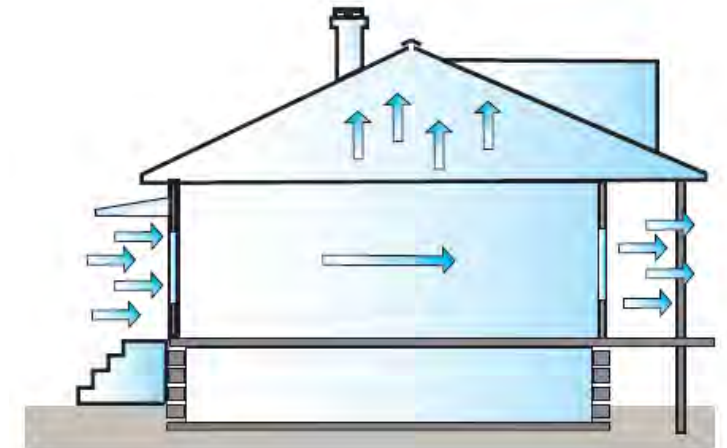
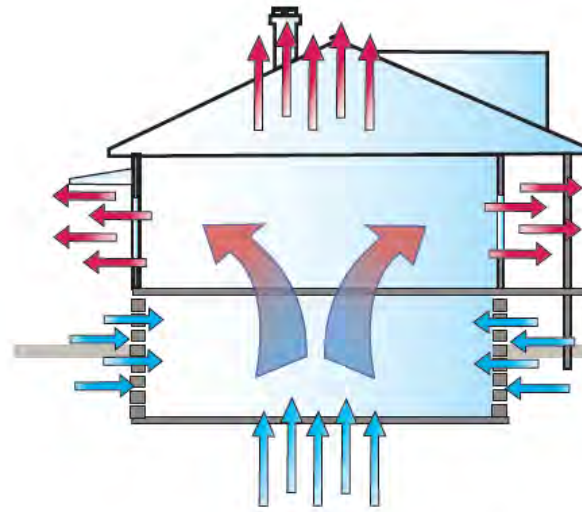
Fan Interference

- Exhaust fans – kitchen, clothes dryer, bath, window, whole house
- Duct leakage
- Interior door closure



Natural Building Leakage

- Stack effect
- Wind effect

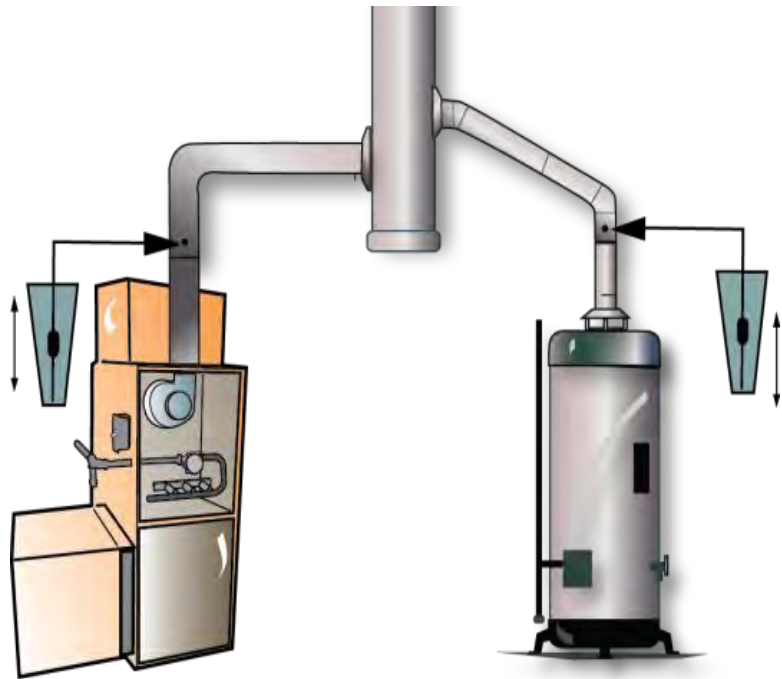


Restricted Flues

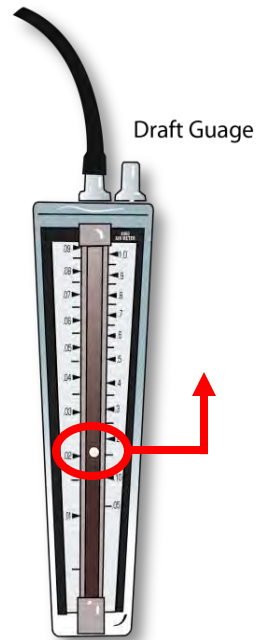
Undersized, restricted, and improperly installed flues will have the same symptoms as a combustion air problem.

They must be uncovered with the Vent Sizing / Restricted Flue Test.

Vent Sizing/Restricted Flue Test



Draft should remain the same and start to fall slowly once the gas valve is turned off. If draft increases for at least 10-15 seconds after the gas valve is turned off, the flue is undersized or restricted and requires repair.



Combustion Readings

Carbon Monoxide

Equipment/Burner Type	Light-off (First 60 seconds)	Run (After five minutes)	Shutdown (Last 60 seconds*)
Natural Draft (70%)	Less than 400 ppm	100 ppm and stable	Falling
Induced Draft (80%)	Less than 1000 ppm	100 ppm and stable	Falling
Condensing (90%)	Less than 1000 ppm	100 ppm and stable	Falling

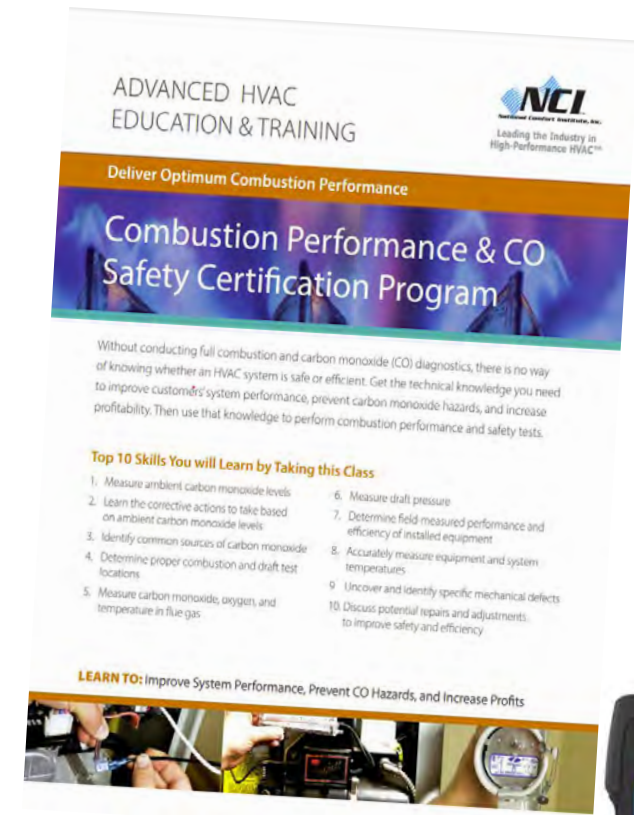
Oxygen (Stable during Run Cycle)

Range

6% to 9% Residential light Commercial Natural Gas, LP (Atmospheric, Induced Draft)

Next Steps

1. Measure ambient CO.
2. Learn to identify visual clues.
3. Get trained in CO and Combustion Testing.
4. Purchase the necessary test equipment.
5. Offer low-level CO monitors to your customers.
6. Start testing your own work and provide solutions.
7. Become the “go-to” company for CO safety.



About NCI

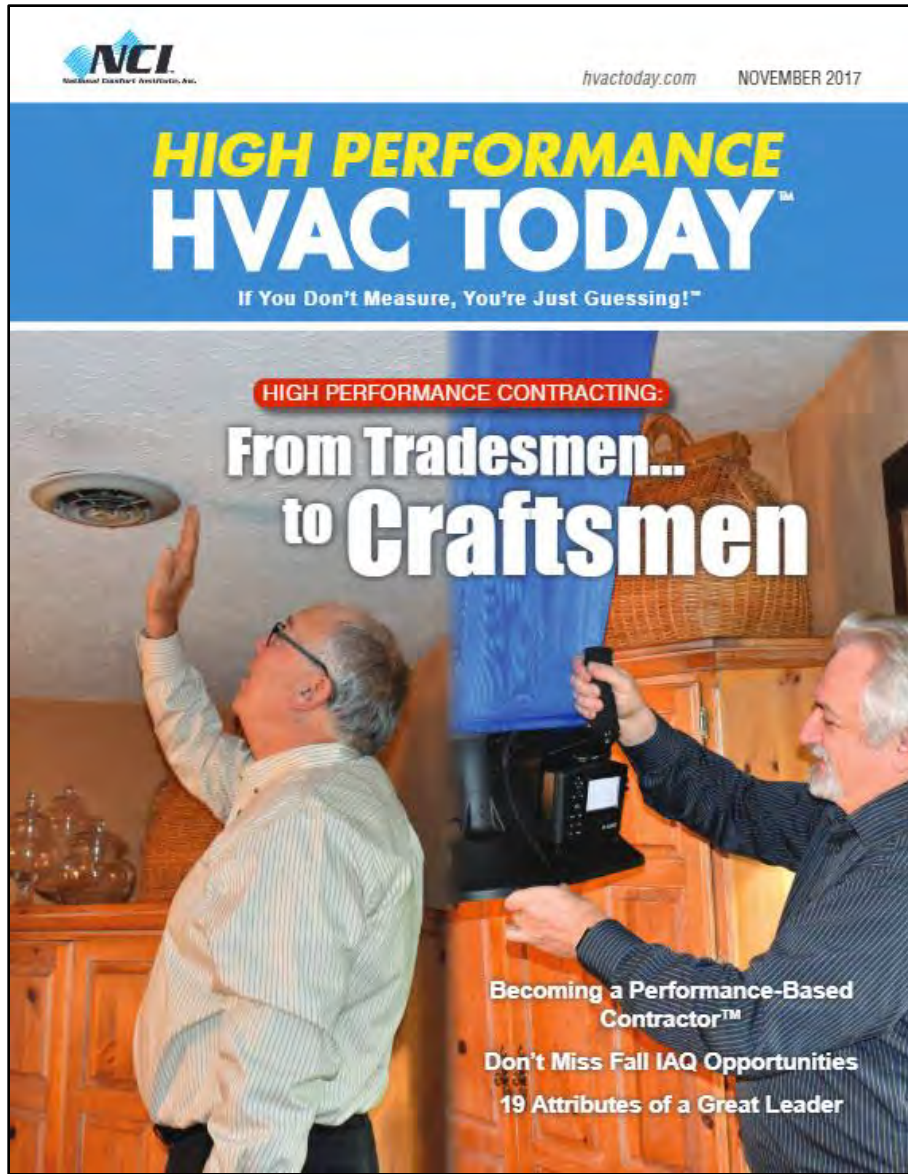
Currently we train over 3,000 industry professionals each year and have certified over 50,000 people since our beginning in 1993.

In addition to innovative business and technical training, we offer memberships with distinctive member benefits.

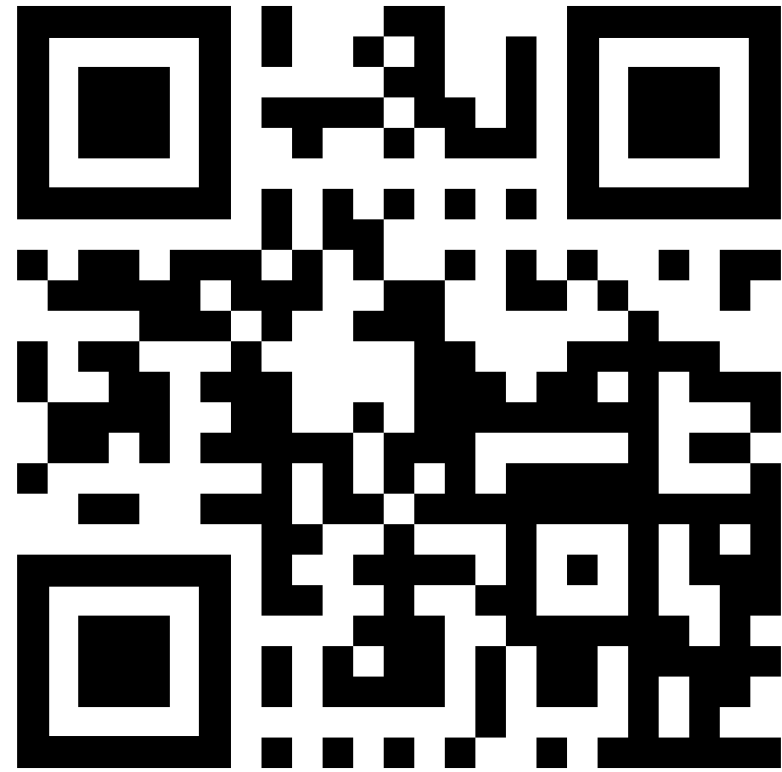
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