

Welcome to TruTech Training!

We'll be starting in just a few moments.....

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Combustion ABC

Combustion **A**nalyzer **B**oot **C**amp

OK, What does this thing do besides calculate furnace efficiency anyway?

**An Introduction
to the
Testo 327 Combustion Analyzer**





Who are we?

- Experienced professionals delivering CEU training to the HVAC and related trades
- 45+ years combined experience
- Practical, related and hands-on training
- Learn while you earn
 - BPI Recognized CEUs on other TTT classes



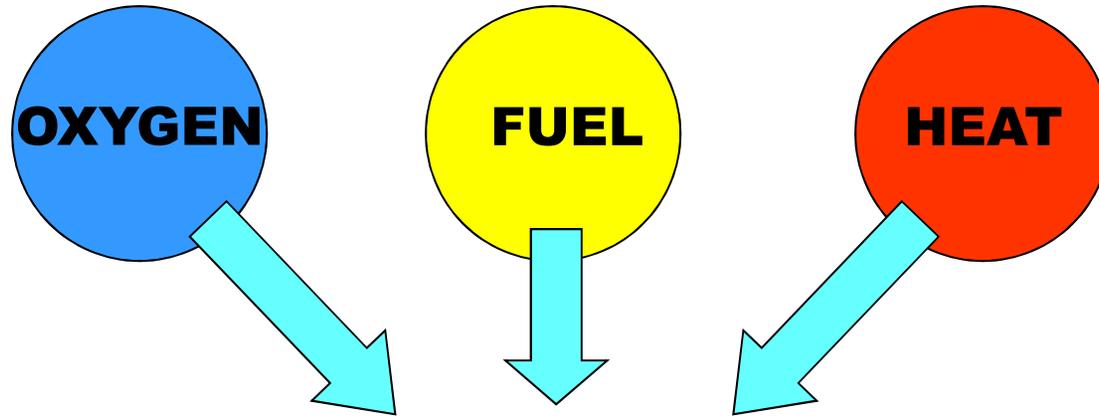
Agenda

- Importance of Combustion Analysis
- Analyzer Over view
- Main Menu Overview
- Measuring Menu
- Flue gas test measurement
- Adjustment Menu
- Set up menu
- Fuel Selections
- Diagnostics
- Calibration
- Filters & Probes
- Pumps & Printers
- Closing thoughts

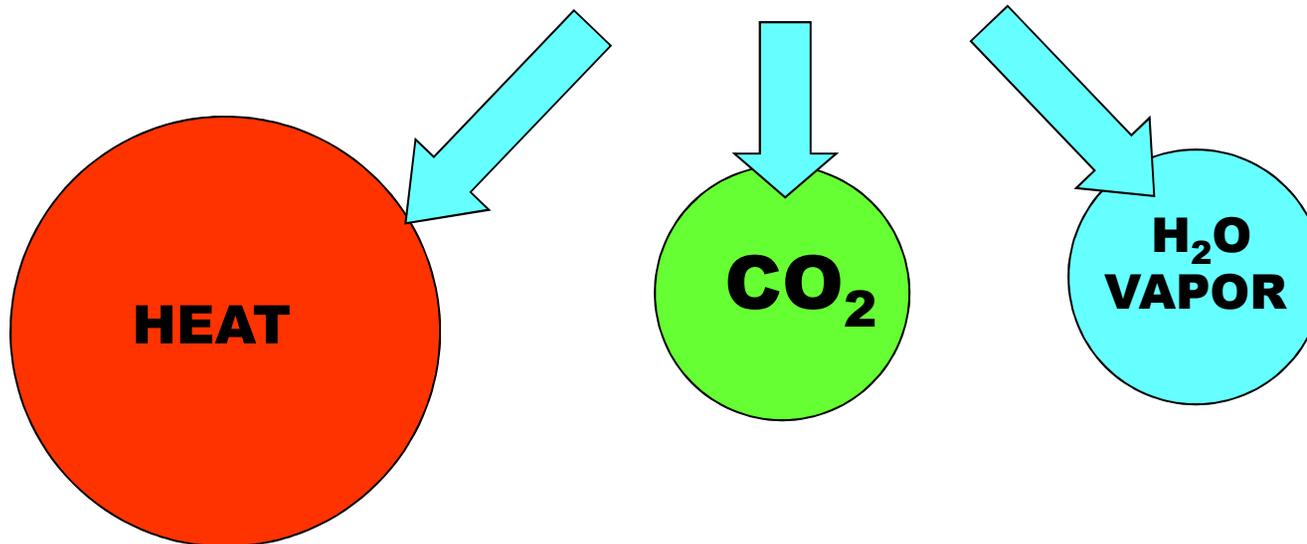


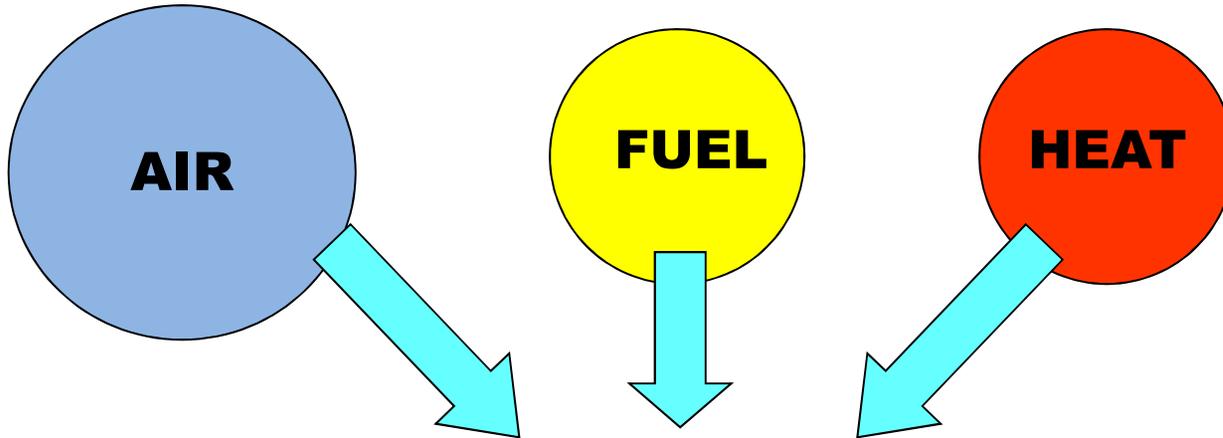
Why is combustion analysis important?

- Verification of the safety of the appliance before and after servicing and or weatherization
- Calculation of the combustion efficiency
- Monitor the pollution the appliance is producing
- To verify conformance with manufacturers' guidelines
- To minimize warranty issues and assure equipment longevity

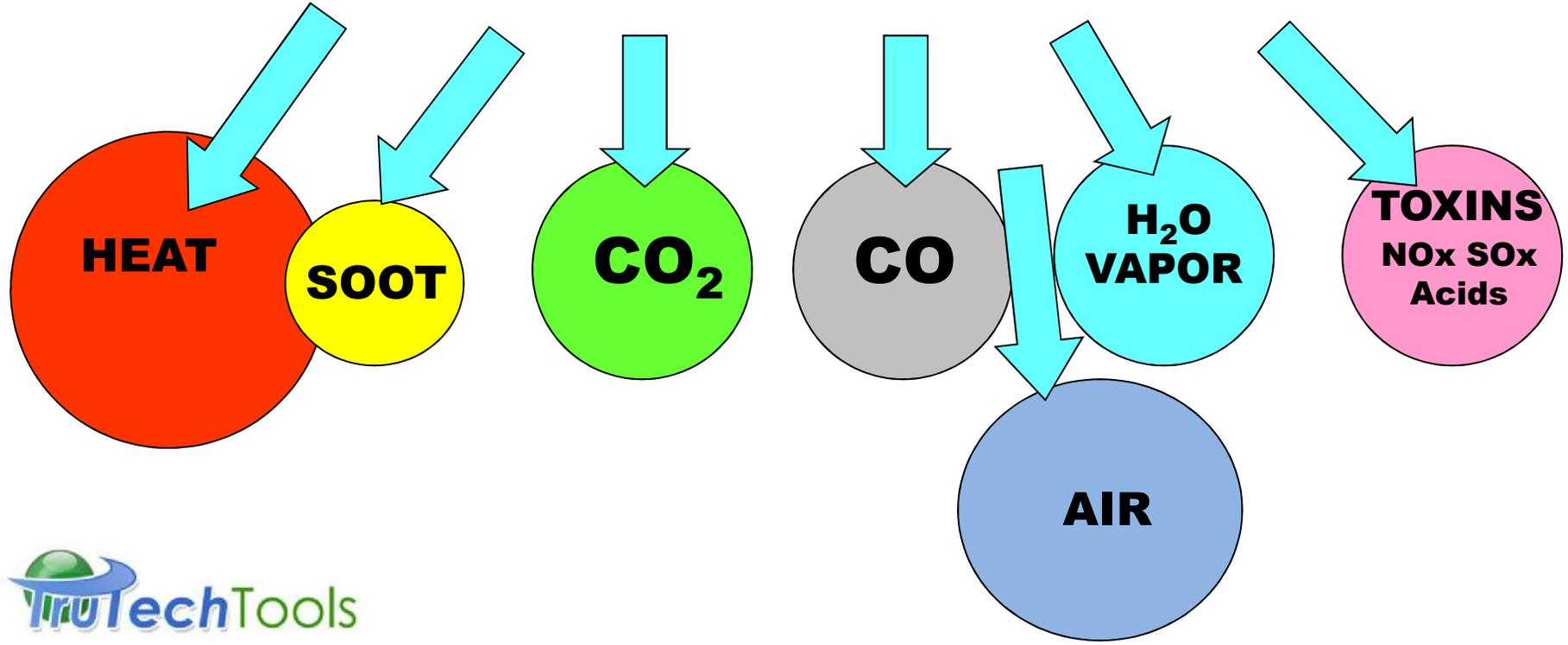


Complete Combustion





INCOMPLETE COMBUSTION



Combustion Analysis

Combustion analysis involves understand the relationship of the gasses and the combustion process to determine proper operation and make adjustments as required for safety and efficiency.

The efficiency calculated by the combustion analyzer is a modified equation that considers combustion efficiency and stack losses.

- Part thermal
- Part combustion efficiency

Complete Combustion Analysis

- Involves testing all appliances
- The venting system
- The combustion air zone
- The building envelope
- And Worst case testing



Easy, but requires training!

You cannot just stick the probe in the stack and push buttons!!!

TruTechTools also offers advanced training!



The logo for TruTech Training, featuring a stylized globe icon to the left of the text "TruTech Training". The text is in a blue, sans-serif font.

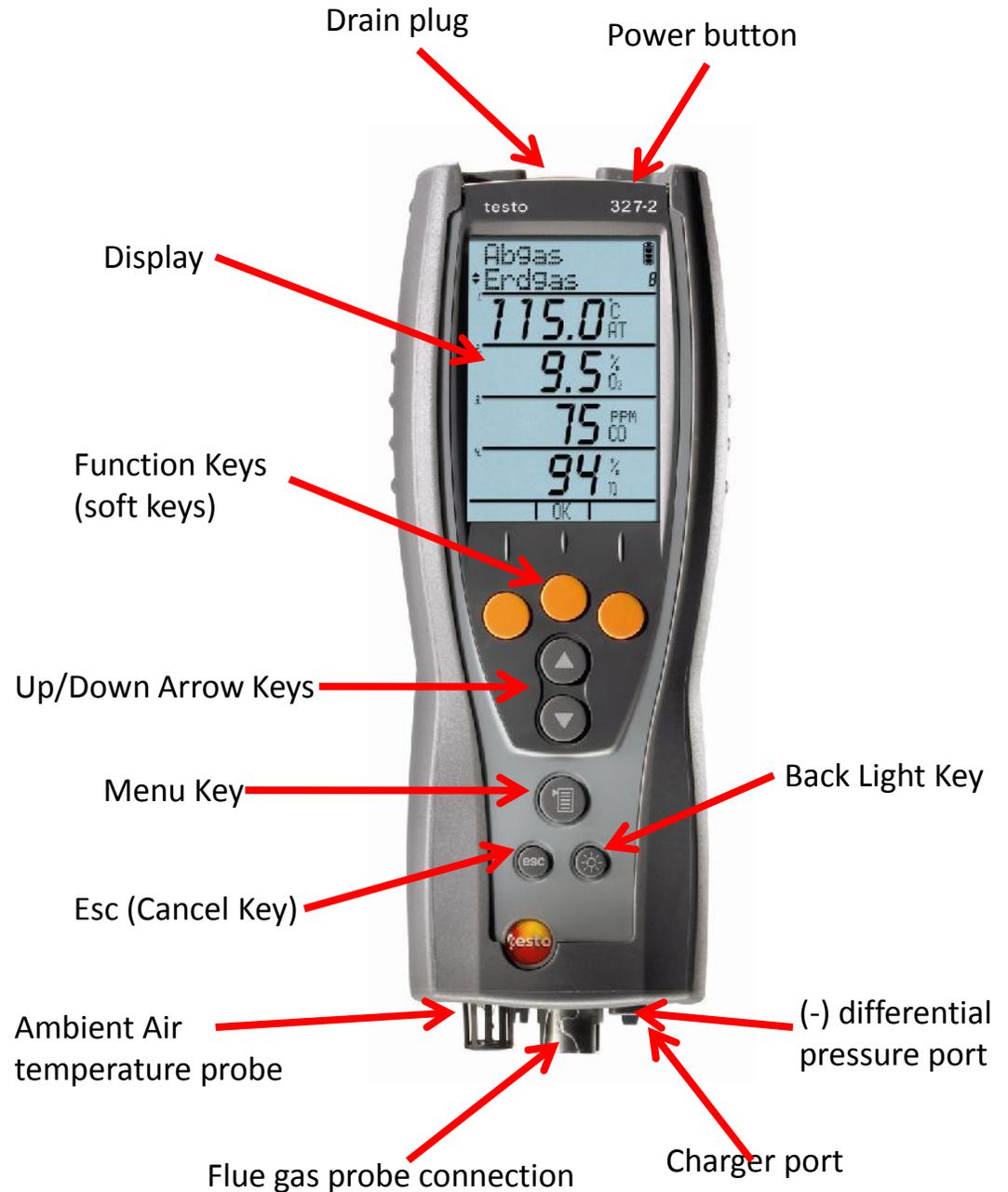
The logo for TruTechTools, featuring a stylized globe icon to the left of the text "TruTechTools". The text is in a blue, sans-serif font.

Testo 327 at a glance

Simply one of the best analyzers on the market for the money

- Designed for residential and light commercial markets
- Easy to use
- Long sensor life
- Customizable menus
- Field serviceable sensors
 - NEED FIRMARE version 1.14+*
- Incorporates NOx filters
- Can measure differential pressure
- Can measure differential temperature
- Can print results w/optional printer

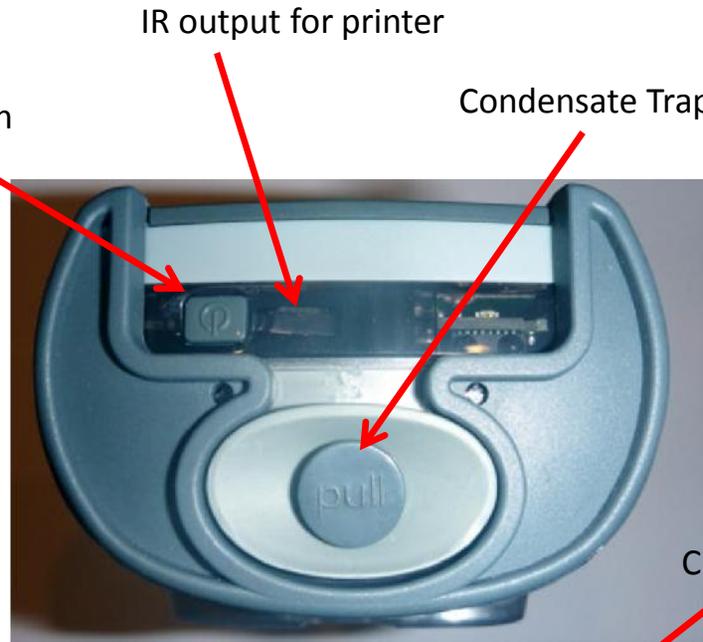
Overview Basic Features



Testo 327 at a glance



Condensate Trap

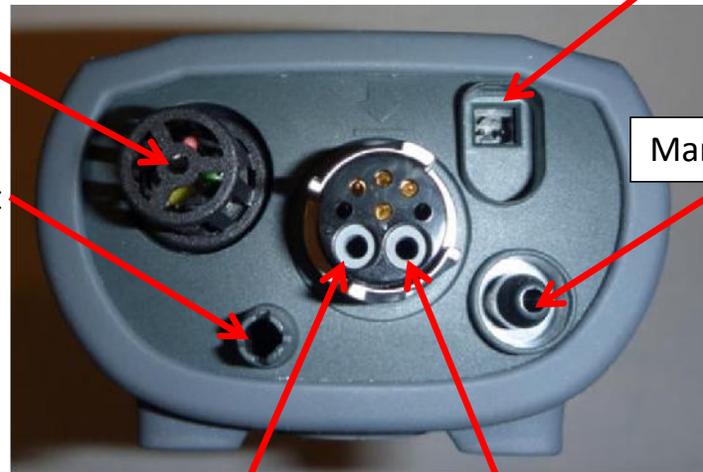


Power Button

IR output for printer

Condensate Trap Drain

REMOVABLE
Ambient/air
temp probe



Charger Port

Manometer (-)

Exhaust Vent

Combustion gas inlet

Manometer (+)

Testo 327 at a glance



Strong Magnets

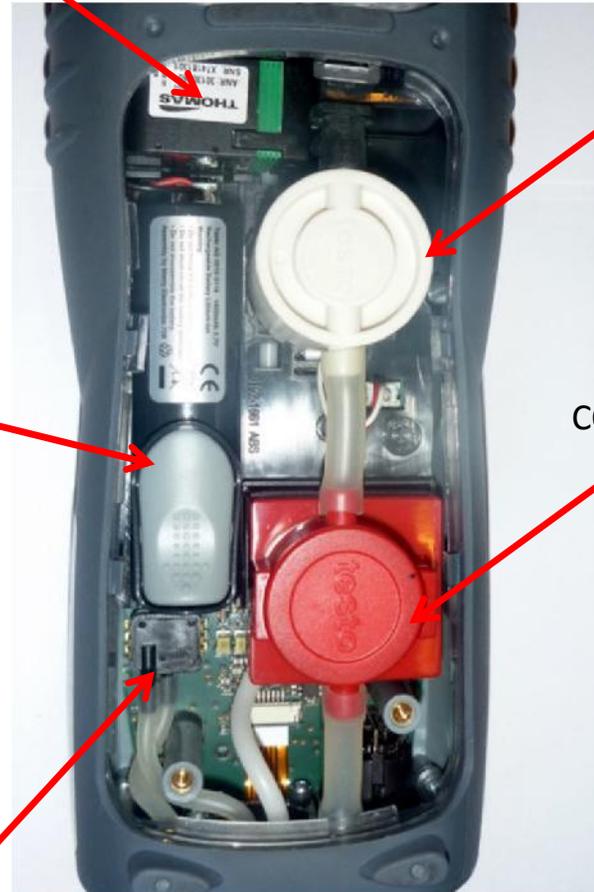
Access Door

Manufacturer's Label

Model No.
Serial No.
Date Code

Pressure Sensor
(Manometer)

Pump



O₂ Cell

CO cell /NOx filter

When CO readings matter...

...never* measure without a
NOx filter

- Comes standard on all Testo!
- Lasts the life of the CO cell
- Without it errors of 40 to 80 PPM (high) possible



*And CO always matters!



Main Menu Overview

- Measuring
 - This is where all tests are performed
- Adjust
 - For field or factory calibrations
- Setup Mode
 - For configuring the analyzer
- Fuel Select
 - For fuel selection
- Diagnostic
 - For troubleshooting meter operation



Measuring

The 327 makes the following stand-alone tests:

- **Flue Gas**
- **Draft**
- **CO-AirFree**
- **Smoke/Oil.derivate**
- **Differential Pressure**
- **Delta Temperature**
- **Ambient CO**



Flue Gas

Properties of the flue gasses both measured and calculated. Used for field diagnostics by the technician.

Draft

Measurement of the pressure in the stack with regards to the combustion air zone (CAZ) pressure. (Stored)

CO Air Free

Measurement of the ambient CO with reference to oxygen (O₂) remaining in the flue gasses. Typically used with Ovens/stoves (Stored)

Smoke / Oil Derivative<- explained later on

User input smoke spot number derived from manual smoke spot test. (averaged and stored)

Differential Pressure

Pressure difference between stack probe and (-) pressure port. Can also be used with an adapter for static pressure (0554 1203) for CAZ pressure measurement or static. (Stored)

Delta Temperature

Temperature difference between stack temperature thermocouple and ambient air probe. This difference is also net stack temperature if measuring flue gas with combustion probe. (stored)

Ambient CO

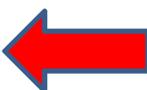
Ambient CO level of the air with respect to an O₂ concentration of 20.9%. (Stored)

Draft

Upon start Draft will zero for 5 seconds

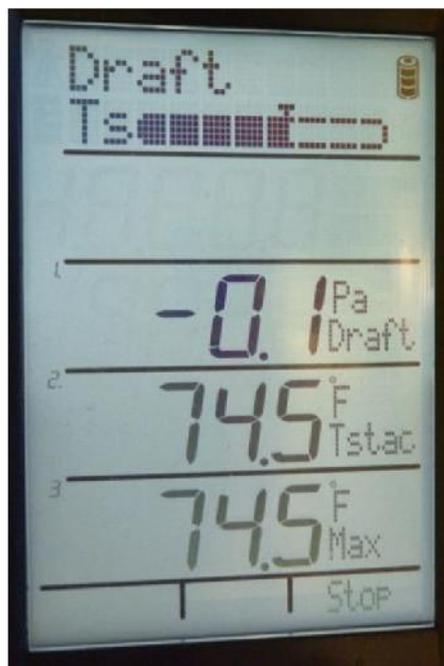
BEFORE EVERY TEST

(no pressures across sensor/out of stack & hoses still)



Stack draft can be measured in "H2O or Pascals (Pa)
(amongst other units or measure)

Temperature records hot spot in the flue-a
repeatable measuring location



CO Air Free

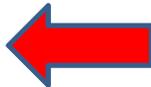
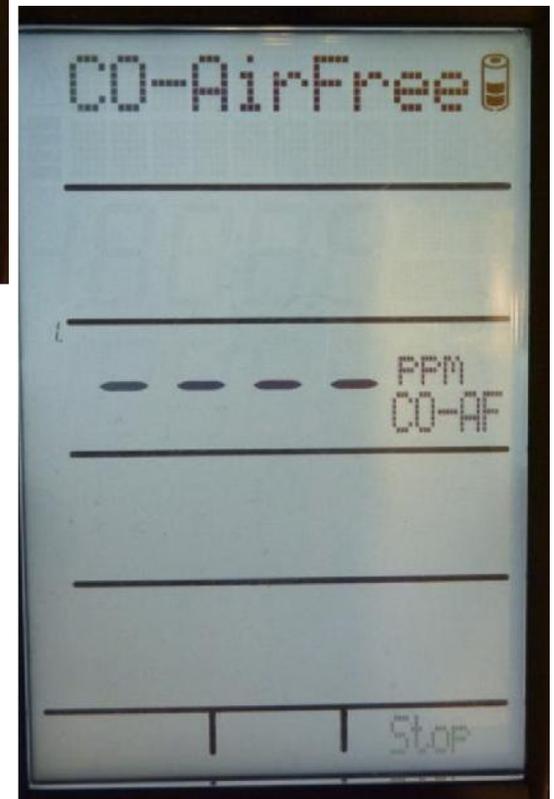
CO AirFree uses the O2 sensor and the CO sensor to calculate an undiluted CO sample

Used on ovens, stoves, and vent free appliances

Until O2 starts to drop below about 18% no calculation is made.

When test is stopped, value is recorded.

The Testo 327 must be zeroed in fresh outdoor air prior testing if this is your first combustion test during a power cycle.



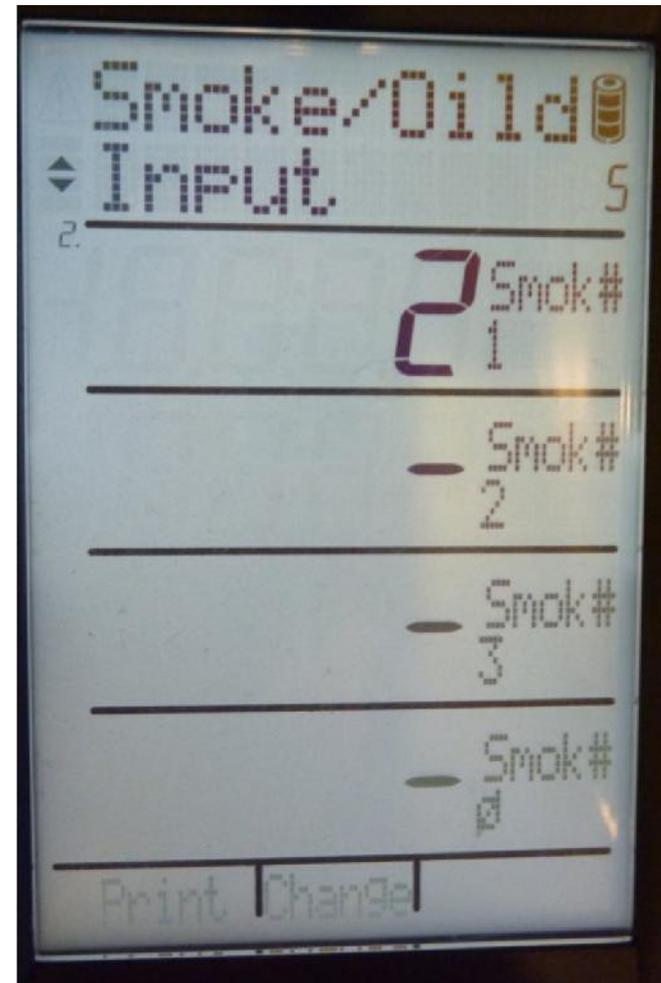
Smoke Oil Derivative

A smoke test can be recorded for an oil burning appliance if desired.

Smoke number is read by the technician and manually input into the instrument

If desired, multiple smoke tests can be recorded

Oil Derivative testing is commonly performed in Europe. You insert the answer (yes/no) if you saw a spot develop, per the test described on the next page.





Oil Derivative: What is it?

TOP
SECRET

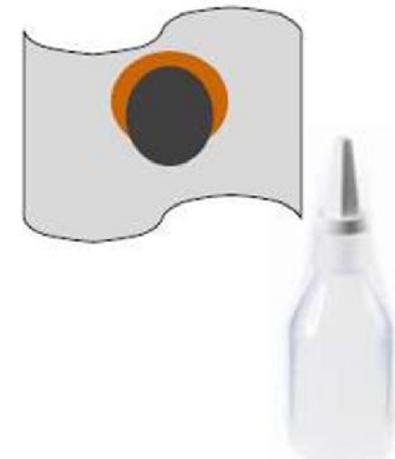
PER DIN 51402-2

If heating oil is not burned completely, flue gases can include oil derivatives, an environmental pollutant.

Oil derivatives are organic substances (not volatile) that become visible by means of Acetone application to the filter paper.

The TEST:

- 1 Apply drops of Acetone close to the Smoke Spot on the Smoke paper.
- 2 If a **distinct** yellow to brown color spreads from the spot, unburned oil is present in the flue gas
- 3 If the color is not present or weak the sample is OK



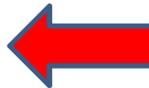
Differential Pressure

With an accessory adapter*, differential pressure can be recorded across filters, heat exchangers, pressure switches, coils or any other device

Upon start Diff Press will zero for 5 seconds

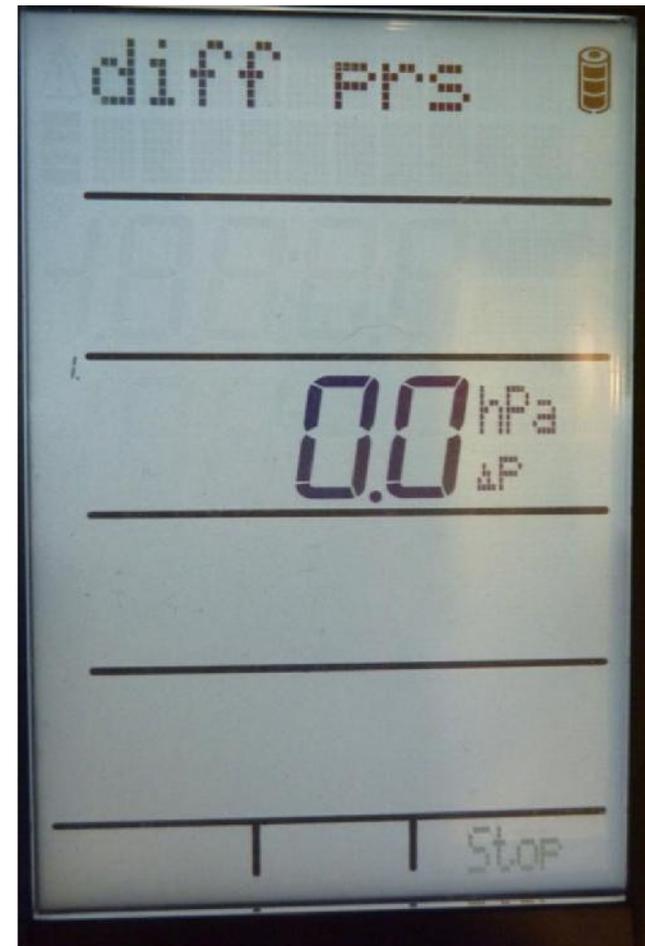
BEFORE EVERY TEST

(no pressures across sensor/out of stack & hoses still)



When **Stop** is pressed, the reading is recorded

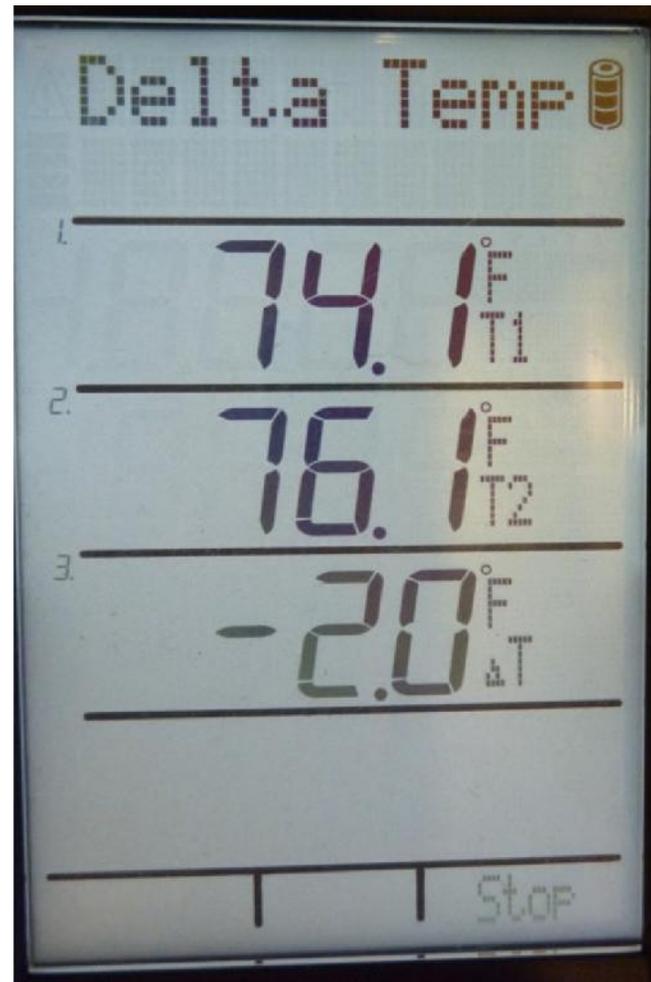
* You can also simply slip a hose over the end of the probe (covering all slots) instead of using an adapter.



Delta Temperature

Differential temperature can be used for temperature rise of furnaces or boilers, calculating net stack temperatures or any other differential temperature application.

Surface temperature and clamp/Velcro® type probes are available as accessories for better measurements.



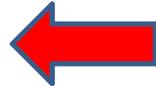
Ambient CO

Ambient CO is used for checking the **CAZ*** environment, and/or the rest of the building.

The Testo 327 must be zeroed in fresh outdoor air prior testing if this is your first combustion test during a power cycle.

Use stack probe during measurement

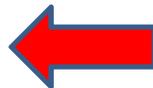
* **Combustion Air Zone**- the surroundings from which the combustion equipment gets its air



Flue Gas Measurement Test

1. Stack Temperature
2. Oxygen (O2)
3. Carbon Monoxide (CO)
4. Carbon Monoxide air free (Coaf)
5. Efficiency (%eff)
6. Excess Air (%ExAir)
7. Dew Point Temperature (°F,°C Dew point)
8. Draft
9. Ambient Temperature
10. Instrument Temperature
11. Delta Temperature
12. Differential pressure
13. CO ambient

The Testo 327 must be zeroed in fresh outdoor air prior testing if this is your first combustion test during a power cycle.



Stack temperature (°F)

Gross stack temperature (Ambient + stack temperature)

Oxygen (O2)

% of oxygen left in the flue gas after combustion (ambient = 20.9%)

Carbon Monoxide (CO)

Raw CO measurement, not corrected for dilution. What the CO sensor sees

Carbon Monoxide air free (CO-AF)

Corrected Stack CO, taking into account dilution by excess air

Efficiency (%Eff)

Estimated efficiency of the appliance taking into account thermal and combustion efficiency

Excess Air (%ExAir)

Percent of oxygen that has gone through the combustion process without being consumed

Dew Point Temperature (°F,°C Dew point)

Calculated temperature at which the flue gasses will start to condense.

Flue Gas Measurement Test Continued



Draft (Pa, InH2O)

Draft recorded during draft test

Ambient Temperature

Temperature of the CAZ.

Instrument Temperature

Internal Temperature of the instrument

Delta Temperature

Temperature difference recorded during differential temperature measurement.

Differential pressure

Pressure difference recorded during differential pressure measurement.

CO ambient

Ambient CO level of the air with respect to an O₂ concentration of 20.9% recorded during ambient CO test.

Adjust Menu

- CO adjust
- O₂-Cal

For factory or authorized
service center use only



Setup Mode

- Display
- Date/time
- Language



Display

Allows user configuration of the display.

- Organize what is important to you.
- Eliminate measurements you do not use.
- Order on screen sets order on print out
- **REMEMBER TO SAVE SETTINGS**
 - MUST SEE Message: Info Accepted

Date/Time

Allows the user to set the date and time.

- Prints out with the optional printer and becomes part of a legal record of service (along with meter serial number).
- Make sure it is set correctly.

Language

Can be configured for English or French

- Currently TruTech Tools can only support instruments configured in English.



Fuel Selections

- Nat gas
- BioHeat 5 (oil)
- Propane
- Oil#2
- Oil#5
- Oil#6
- Kerosene
- Wood



Fuel selections are important for efficiency calculations. Each fuel has a specific and measurable heat content that is referenced from this variable.

Diagnostic

- Info
- Error
- Battery

Info provides information on:

- Instrument Model
- Instrument Serial
- Instrument temperature (°C only)
- Number of hours of run time

Error provides information on:

- Device errors, record two digit number switch off analyzer and contact service

Battery

- Shows battery voltage Nominal voltage is 3.7 volts DC
- Continuous run time about 4 hours
- Charge time 5-6 hours

INSIDE INFO

- The meter tracks run time and sensor Overrange and is read by factory authorized service.



Combustion Analyzers

Taking care of your investment and your results

- Calibration (~1 per year)
- Service
 - Pumps, filters and probes
- Storage temperature limits
 - Condensation
- Fresh Air Purge
- Sensor Range (CO)
 - Exceeding range can limit sensor life
 - Automatic over-range protection available in some models



Care of Combustion Analyzers -The Basics

- Batteries
 - Proper type (Alkaline, battery packs or rechargeables)
 - New or fresh
 - Leakage
 - Do not mix old and new
 - Power supplies and rechargeables
- Cold storage
 - Impact on sensors
 - LCD displays
 - Batteries
 - Remaining condensate
- High temperature exposure
 - Analyzer body
 - Probes



Filters

- Condensate and water trap
 - Emptying
 - Cleaning
 - Maintaining
 - Changing
 - Air tightness
- Particulates and filters
 - Cleaning
 - Maintaining
 - Changing



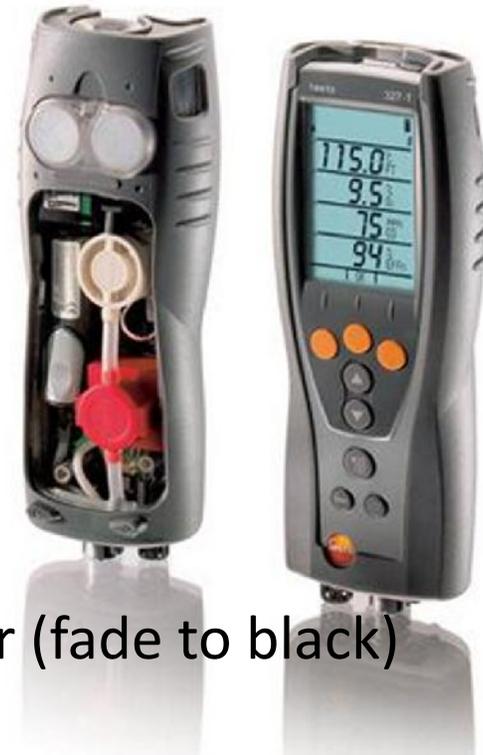
Probes

- **Thermocouples**
 - Temperature exposure
 - Mechanical damage
 - Straining wires and plugs
 - Thermocouple connections
 - - wear and tear
- **Hoses**
 - Temperature exposure
 - Cracks and holes
 - Leak testing
 - Hose connections, seals, o-rings, lubes



Pumps & Printers

- Pumps
 - Break down
 - Clogging
 - Cleaning diaphragms
 - Change out
- Printers
 - Fresh batteries
 - Proper paper loading
 - High temp exposure of printer paper (fade to black)
 - Use of "office supply" brands
 - Longer life papers (up to 10 years)



Using your head!

- Read the manual
 - Familiarize yourself with analyzer before using – re-read before season starts
- What to look for if readings do not look right
 - Eg. An unusually high O₂ or low CO₂ reading is likely a sampling system leak, torn hose assembly, etc.
 - Do not lose faith in the unit.
- You can understand it!



Additional Probes and Accessories

Some things to consider.....



0554 1203 Adapter for pressure readings

0554 1202 Hose Extension 9'

0600 9787 Combustion air temperature probe 7.5"

0600 9791 Combustion air temperature probe 12"

0600 9797 Combustion air temperature probe 2.4" w 13' cable

0554 0549 Fast IR printer



Cases and printers and ***DIGITAL*** and mechanical smoke pump tests are available

Combustion Testing Results

- Saves money
- Saves time
- Avoids callbacks
- Limits liability
- Maintains equipment warranty
- Provides confidence
- Provides increased comfort
- Provides increased safety
- Increases energy efficiency
- Lowers environmental emissions (Pollutants)

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PRODUCT REVIEW of this webinar
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