REFERENCE GUIDE AND GLOSSARY

IMPORTANT: Before using Tune-Rite™, be sure to read the following:

- the INSIGHT® Plus Instruction Manual
- the Tune-Rite™ Operation Manual
- all associated documentation from the appliance manufacturer.

US-based manufacturer since 1909

This flip chart provides a glossary of common HVAC and combustion analysis terms as well as sample reference screens of Tune-Rite™ functional processes.

GLOSSARY OF TERMS

Air – Mixture of 21% O_2 and 79% N_2. Air is a required component for the combustion of any fuel.

Air Filter – Device that removes debris and particles from air circulating through a heating or air handling system.

Air Leakage – Air leaks into the combustion chamber due to a faulty seal around the secondary air openings of the appliance. Seal such leaks by replacing the gasket or tightening screws. Can also be caused by failure to close the furnace door, improperly installed replacement parts, and other issues.

SELECT FUEL (NG OR OIL)

Power on.

Select FUEL option from MAIN MENU.

Press ENTER.

Highlight a Tune-Rite™ supported fuel from fuel list.

Press ENTER.

Go back to MAIN MENU.

Ambient – Surrounding conditions. For combustion purposes usually means the air surrounding the appliance. Sometimes referred to as *envelope air*.

Aquastat – A temperature-actuated electric switch used to limit and control the temperature of boiler water.

Atmospheric Burner – Burner that uses ambient air supply at atmospheric pressure for combustion air.

Atmospheric Draft Gas Furnace (70+) – Heating system that uses ambient air supplied at normal atmospheric pressure for combustion. Flue gases are usually vented naturally under negative pressure through a metal pipe (class 2 B-vent, chimney liner).

Atomization – Reduction of a fluid to small particles. For combustion purposes an oil burner produces a fine mist of fuel to promote and improve combustion.

Baffle – A device used to restrict the flow of flue gas through a heating system. Sometimes called a *turbulator*.

Barometric Damper – An adjustable and self-regulating damper positioned in the flue or chimney so that atmospheric pressure can control the air flow through the combustion chamber and flue. Sometimes called a *draft regulator*.

START TUNE-RITE™

Blower – Mechanical device that consists of moving blades or vanes that force air through a heating system.

Boiler – A heating appliance that heats water with hot combustion gases, and uses that water (or steam) for heating a building, making domestic hot water, or for a working process.

Breech – Passageway leading from a furnace or boiler to its chimney.

Burner – Heat-producing element of a combustion system that positions a flame in a desired location by delivering fuel and air to that location in such a manner that continuous ignition is accomplished.

Burner Alignment – The relative location of the burner. Ideally it should be centered such that the flame does not touch any burner drawer surfaces.

Burner Drawer – The area where the burner and burner controls are located in a furnace or boiler. Sometimes called the *burner box*.

Carbon Monoxide (CO) – CO is a poisonous and odorless gas. For combustion purposes it is the byproduct of incomplete combustion of the available carbon in the fuel.

SELECT APPLIANCE TYPE

Highlight Appliance Type from list.

The appliance types listed will vary based on the fuel you selected earlier.

Press ENTER.

Carbon Dioxide (CO_2) - For combustion purposes CO_2 is a byproduct of complete combustion of the available carbon in the fuel.

Chimney – Passageway for exhausting combustion gases from a heating appliance/fireplace to the outdoors.

Clock the Meter – Method used to determine the actual fuel input rate of a gas appliance by determining the time it takes to use a known volume of gas that has a known energy value.

COAF – CO air-free (COAF) is a measurement of CO in the flue gas or air sample that takes into account the excess air in the sample and incorporates an adjustment to the as-measured CO ppm value, thus simulating air-free (no excess air) conditions in the sample.

Combustion – The rapid reaction of fuel and oxygen usually resulting in the generation of heat.

Combustion Appliance Zone (CAZ) – An enclosed air volume that contains a combustion appliance, including mechanical room and main body of the house.

SELECT COMBUSTION ANALYSIS

Highlight Combustion from the Analyze Menu.

Press ENTER.

Perform a draft test before the combustion analysis to verify proper draft in the system.

For oil-fired equipment, perform a smoke test using True Spot® Smoke Tester before a combustion analysis.

Condensate – For combustion purposes condensate is the liquid formed by the condensation of water vapor as the temperature of the flue gas drops below its dew point (approximately 139° F, but varies as a function of fuel type and excess air). Condensate is typically produced and drained from 90+ high efficiency furnaces.

Condensing Gas Furnace (90+) – Heating system that uses a fan (*inducer*) to supply a controlled amount of ambient air for combustion and for clearing the heat exchangers of exhaust gas. Typically utilizes both a primary and secondary heat exchanger to extract additional heat from flue gases. Flue gases are vented under positive pressure. Sometimes called a *direct vent furnace*, *high efficiency furnace*, or *sealed furnace*.

Condensing Heat Exchanger – Device used for transferring heat from one fluid to another by further reducing stack temperature below the dew point of the flue gas to extract additional heat. Sometimes called a *secondary heat exchanger*.

OR... ANALYZE DIRECTLY FROM THE MAIN MENU

Highlight Analyze from the Main Menu.

Press ENTER.

Selecting the analysis *type* is performed sequentially *after* selecting the appliance type. You can *also* perform an analysis from the main Tune-Rite™ menu.

Cracked Heat Exchanger Check – A method used to determine whether or not a primary or secondary heat exchanger has been compromised (cracked). General inspection methods include some or all of the following:

- a visual test
- pressure test
- leak test
- observation of certain characteristic furnace functions.

A heat exchanger should be replaced if there is *any* indication (*no matter how small*) of a crack, leak, pressure fail, or functional compromise.

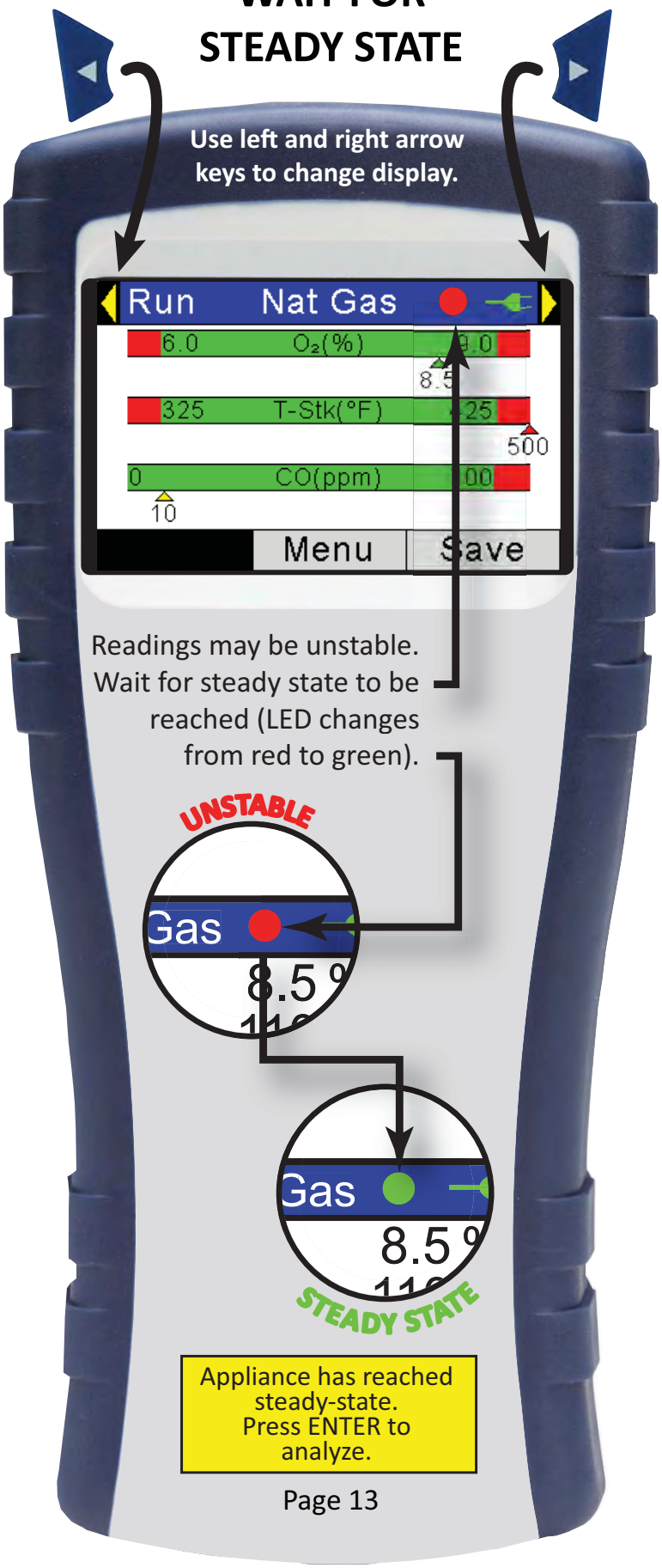
Debris – Dirt, dust, construction material, or lint in or around the burner.

Dew Point – Temperature below which moisture (water vapor) in the flue gas begins to condense. Flue gas dew point is a function of the fuel type and the amount of excess air.

Draft – For combustion purposes draft is a difference in pressure that causes a flow of air and flue gas through the appliance, the appliance vent, and the chimney.

Excess Air– The air remaining after a fuel has been completely burned or the air supplied in addition to the quantity required for perfect combustion.

WAIT FOR STEADY STATE



Appliance has reached steady-state. Press ENTER to analyze.

External Static Pressure (ESP) – The pressure that the blower of a heating/cooling system has to overcome due to ductwork, fittings, filters, dampers, grilles, and other equipment resistance, in order to supply the proper amount of heated/cooled air to the living space.

Flame Impingement – Condition existing when the flame resulting from the combustion of a fuel comes into contact with any interior surface of the combustion system.

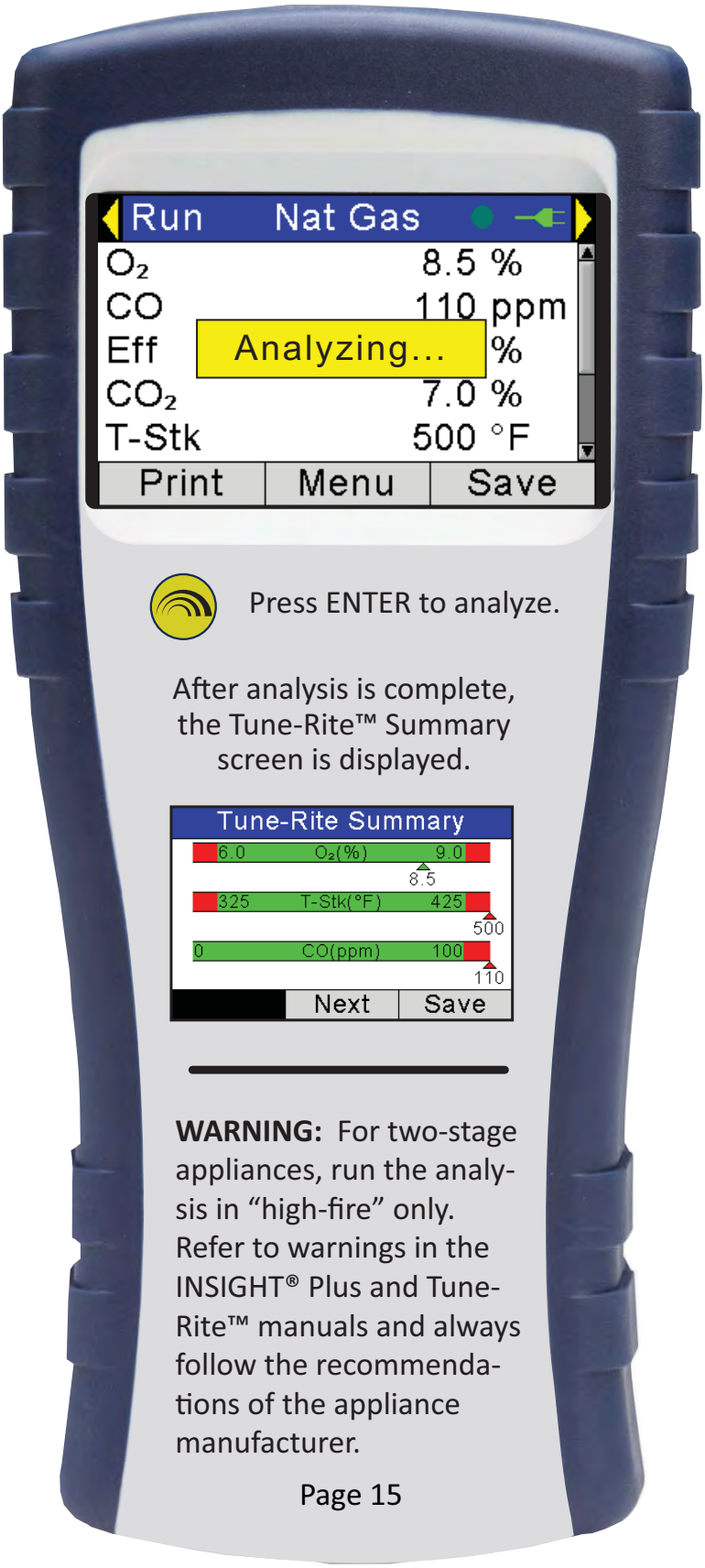
Flue Gas – Includes all gases that leave the combustion appliance by way of the flue pipe, chimney, or vent. Flue gas consists of carbon dioxide (CO_2), water (H_2O), nitrogen (N_2), oxygen (O_2), and trace gases that might include carbon monoxide (CO), nitric oxide (NO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2).

Fuel – Any substance (gas, liquid, or solid) used for combustion.

Furnace - A heating appliance that heats air with hot combustion gases.

Gas Orifice – A precisely sized hole through which gas is supplied to a burner in a combustion appliance.

START COMBUSTION ANALYSIS



Press ENTER to analyze.

After analysis is complete, the Tune-Rite™ Summary screen is displayed.

WARNING: For two-stage appliances, run the analysis in "high-fire" only. Refer to warnings in the INSIGHT® Plus and Tune-Rite™ manuals and always follow the recommendations of the appliance manufacturer.

Heat Exchanger – A device used for transferring heat from one fluid (including air) to another without allowing the fluids to mix.

High Fire – A relative term meaning that the input rate to a burner is at or near its maximum.

Igniter – Electronic hot-surface ignition source used to ignite the fuel at a burner and start the combustion process.

Induced Draft Gas Furnace (80+) – Heating system that uses a fan (*inducer)* to supply (or *draw*) a controlled amount of ambient air for combustion and assists in venting flue gases out of the heat exchanger. Note that flue gases can be vented under positive or negative pressure.

Inlet Gas Pressure – Gas pressure as delivered from the gas meter to the appliance. Typically measured just before the gas valve.

Low Fire – A relative term meaning that the input rate to the burner is at or near its minimum.

Manifold Gas Pressure – Gas pressure as delivered to the burners from the appliance gas valve. Typically measured at or just after the gas value.

REVIEW RESULTS

- Stable, outside range
- Unstable
- Stable, inside range

F3

Press SAVE to store "As Found" data for use later in print report.

F2

From the summary screen, press NEXT to show a prioritized list of possible causes why readings are outside of acceptable ranges.

Manometer – Device used to measure pressure or differential pressure.

Net Stack Temperature – Stack temperature minus combustion air temperature.

$$T_{STK}\ Net = T_{STK} - T_{AIR}$$

Used in the calculation of combustion efficiency.

Nitrogen (N_2) – For combustion purposes N_2 is a component of air that is unnecessary for the combustion of any fuel.

Non-Retention Oil Boiler – Oil heat system that utilizes a conventional non-flame retention head.

Nozzle – A device used to meter the amount of fuel oil entering the combustion process. The nozzle atomizes (breaks into small droplets) the fuel oil and then delivers it in a specific pattern and at various angles.

Oil Filter – A device used to protect the oil heating system components by trapping contaminants before they reach the pump and nozzle.

Oil Pressure – Pressure of the fuel oil as delivered from the oil pump to the burner.

Over-fired – Operating a furnace or boiler at an input rate in excess of its rated capacity.

REVIEW POSSIBLE CAUSES

Scroll through possible cause list. Highlight cause to investigate.

Press ENTER to see a prioritized solutions checklist associated with the selected cause.

Oxygen (O_2) – For combustion purposes O_2 is the component of air that is necessary for the combustion of any fuel. O_2 is also a component of flue gas and is measured to help determine excess air, carbon dioxide concentration, and combustion efficiency.

Pilot – A small flame used to light a burner. A *standby pilot* will burn throughout the entire period that a furnace is in service whether or not the main burner is firing. An *ignition pilot* will burn during the flame establishment period and is cut off at the end of the period.

Power Burner – A burner in which a fan or blower is used to control the combustion air supply to the burner usually under negative air pressure.

Primary Air – Air that mixes with the fuel (*at* or *in* the burner) to support combustion.

Recirculation – The unwanted recirculating of flue gas (*exhaust gas*) into the combustion air intake pipe. Usually occurs in a sealed combustion, direct vent, two-pipe system that has its air intake and exhaust vents improperly installed on the outside of the home.

INSPECT AND REPAIR
POSSIBLE CAUSES

Scroll through checklist.

IMPORTANT: Inspect, adjust, and/or repair the appliance based on safety guidelines, local regulations, the appliance manufacturer's recommendations, and system guidance from Tune-Rite™. Refer to the INSIGHT® Plus Instruction Manual for further safety details.

Retention Oil Boiler – Oil heat system that utilizes a flame retention combustion head. The burner flame is generally held closer to the burner head and is smaller than conventional burner flames.

Secondary Air – Additional combustion air that is brought into a combustion system around the burner.

Smoke – Unburned particles of carbon that are carried away from the flame by the convection currents generated by the heat of the flame.

Soot – Unburned particles of carbon that collect on burners, in combustion chambers, on heat exchangers, or in the flue.

Stack Temperature (T-Stack) – The temperature of the combustion gases leaving the appliance. T-Stack is an indication of energy that did not transfer from the fuel to the heat exchanger.

Steady State – Property of a combustion system whose parameters (oxygen, stack temperature, carbon monoxide, etc.) have reached a point where they are not significantly changing with time.

TRACK YOUR EFFORTS

Temperature Rise –The difference between the supply and return air temperature in a heating system, sometimes called *ΔT* (*delta T*).

$$\text{Temp Rise} = T_{Supply} - T_{Return}$$

For proper furnace operation the airflow over the heat exchanger is important. Insufficient airflow can result in premature heat exchanger failure. Excessive airflow can result in corrosion of the heat exchanger.

Thermostat – A temperature-actuated electric switch that operates and controls burners, heating elements, and cooling elements of a heating and cooling system.

Turbulator (Burner) – For oil combustion purposes, a turbulator is a device that is used to help mix air and fuel oil. Also called a *combustion head*.

Under-fired – Operating a furnace or boiler at an input rate that is below its rated capacity.

Vent – Passageway for exhausting combustion gases from a heating appliance to the outdoors.

∇ ∇ ∇

RE-ANALYZE AFTER REPAIRS

Select Analyze from the Main Menu.

Press ENTER to start analysis again.

Wait for steady state. Then confirm readings are in range.

F3 Save "as left" data.

F2 Press NEXT for results.

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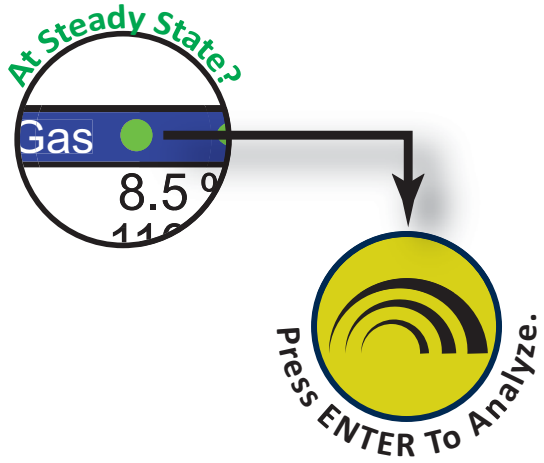

BUTTON SUMMARY

	Power (On/Off)
	Navigation; Scrolling; Changing Values
	Proceed; Perform the Selected Action; Analyze System; Enter
	Toggle Between Run and Hold Modes; Toggle Pump
	Cancel Operation; Go Back to Previous Screen
	Soft Keys; Activate Functions on Display

REVIEW FINAL RESULTS

Adjustments and repairs moved combustion variables into acceptable ranges.

F1 Press LIST to review what was done.

F3 Press SAVE to store checklist-data.

F2 Press BACK to return to Results page.

F2 Press MENU to return to the Main menu.

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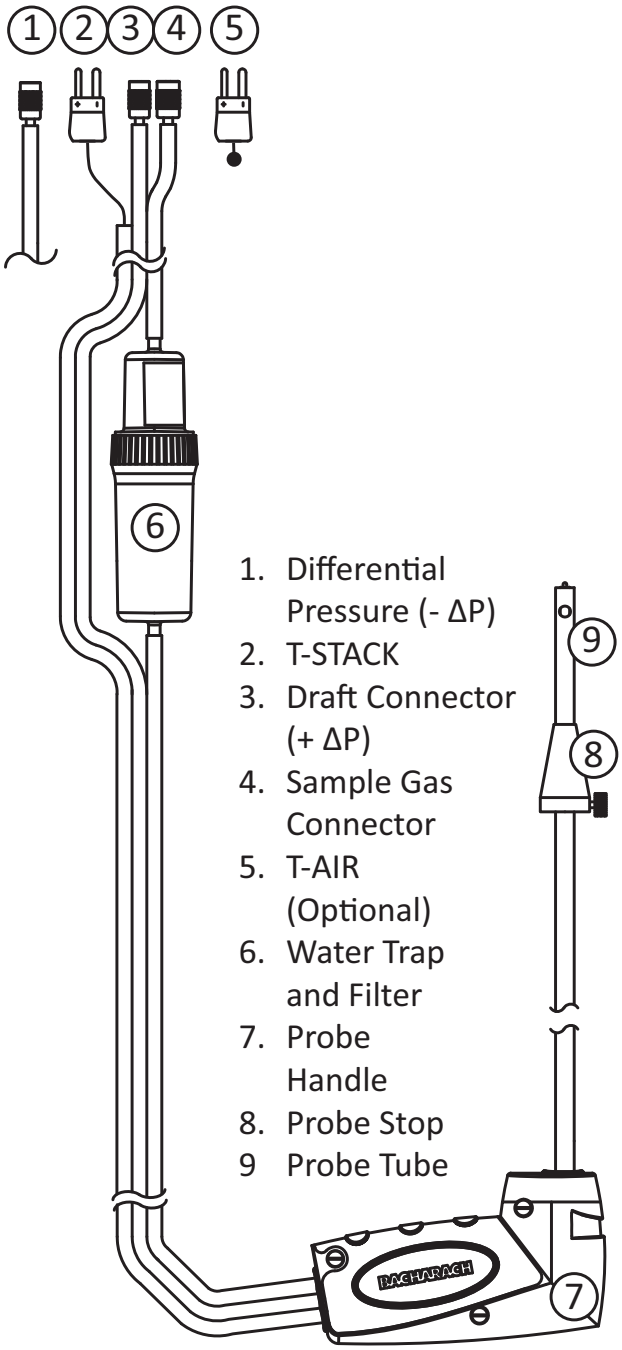
PROBE DETAILS



1. Differential Pressure (- ΔP)
2. T-STACK
3. Draft Connector (+ ΔP)
4. Sample Gas Connector
5. T-AIR (Optional)
6. Water Trap and Filter
7. Probe Handle
8. Probe Stop
9 Probe Tube

BUILD REPORT

WARNING: To avoid introducing dangerous exhaust gases into the space, be sure to completely and securely seal any sampling holes made in the exhaust pipes and ducts.

Highlight the Memory option in the Main Menu.

Press ENTER.

Highlight the Print Report option.

Press ENTER.

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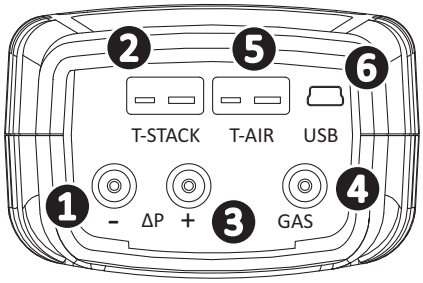
CONNECTOR DETAILS



BOTTOM VIEW

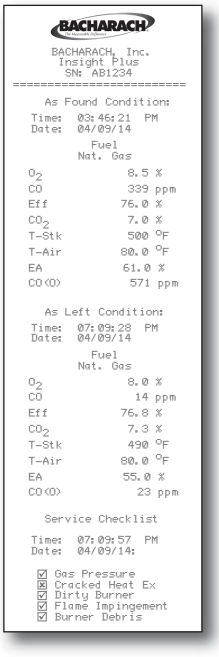
1. Differential Pressure Connector (-ΔP)
2. Stack Temperature Connector (T-STACK)
3. Draft Connector (+ΔP)
4. Sample Gas Connector
5. Air Temperature Connector (T-AIR)
6. USB Connector (Mini B)

REPORT COMPONENTS

Select “As Found” Combustion Record (“C” Suffix) To Be Printed Here

Select “As Left” Combustion Record (“C” Suffix) To Be Printed Here

Select Optional Check-List Data (“L” Suffix) To Be Printed Here



BACHARACH

BACHARACH, Inc.
Insight Plus
SN: AB1234

As Found Condition:
Time: 03:46:21 PM
Date: 04/09/14

Fuel
Nat. Gas

O_2	8.5 %
CO	339 ppm
Eff	76.0 %
CO_2	7.0 %
T-Stk	500 °F
T-Air	80.0 °F
EA	61.0 %
CO(0)	571 ppm

As Left Condition:
Time: 07:09:28 PM
Date: 04/09/14

Fuel
Nat. Gas

O_2	8.0 %
CO	14 ppm
Eff	76.8 %
CO_2	7.3 %
T-Stk	490 °F
T-Air	80.0 °F
EA	55.0 %
CO(0)	23 ppm

Service Checklist
Time: 07:09:57 PM
Date: 04/09/14:

- ☑ Gas Pressure
- ☒ Cracked Heat Ex
- ☑ Dirty Burner
- ☑ Flame Impingement
- ☑ Burner Debris

SELECT REPORT COMPONENTS

Highlight desired "As Found" combustion record.

- **C** **Combustion Record**
- **L** **Checklist Data**
- **P** **Pressure Data**
- **T** **Temperature Data**

Press ENTER to view and confirm.

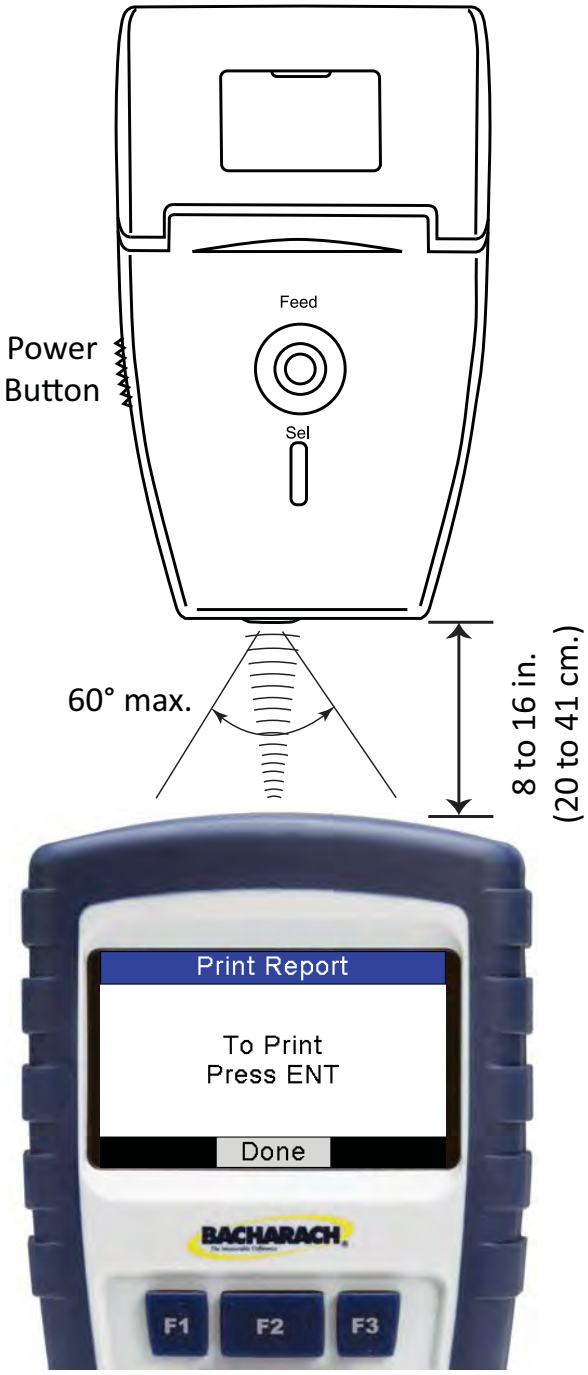
Press ADD to add the record to the report.

Repeat these steps for "As Left" combustion record and optional "Checklist" data.

Fyrite® INSIGHT® PLUS

POWERED BY Tune-Rite™ SOFTWARE

PRINTER ALIGNMENT



PRINT REPORT

Turn on and align your printer.

Press ENTER to print the final service report.

F2

Press DONE to return to the Main Menu.

Fyrite® INSIGHT® PLUS

POWERED BY Tune-Rite™ SOFTWARE

SAMPLE PRINTOUT

BACHARACH
The Measurable Difference

BACHARACH, Inc.
Insight Plus
SN: AB1234

==========

As Found Condition:

Time: 03:46:21 PM
Date: 04/09/14

Fuel	Nat. Gas
O_2	8.5 %
CO	339 ppm
Eff	76.0 %
CO_2	7.0 %
T-Stk	500 °F
T-Air	80.0 °F
EA	61.0 %
CO(O)	571 ppm

As Left Condition:

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Service Checklist

Time: 07:09:57 PM
Date: 04/09/14:

- ☑ Gas Pressure
- ☒ Cracked Heat Ex
- ☑ Dirty Burner
- ☑ Flame Impingement
- ☑ Burner Debris

EXIT TUNE-RITE™

Highlight the EXIT TUNE-RITE option.

Press ENTER to exit.

Select YES option to confirm exit.

Press ENTER to leave the TUNE-RITE™ screens and go back to the analyzer's standard Main Menu.

IMPORTANT: When you exit Tune-Rite™, all "possible cause" tracking information is reset. Be sure to save your checklist before exiting Tune-Rite™.

Tune-Rite™
Reference Guide
and Glossary

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