

WÖHLER

Operation Manual
Flue Gas Analyzer



Wohler A 400
Wohler A 400^{PRO}
Wohler A 400 L

p/n 22159 – 2012-02-21

The Measure of Technology

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1 General Information

1.1 Operation Manual Information

This operation manual allows you to safely work with the Wohler A 400 Flue Gas Analyzer. Please keep this manual for your information.

The Wohler A 400 should be used by trained professionals for its intended use only.

Liability is void for any damages caused by not following this manual.

1.2 Notes



WARNING!

Not following this warning can cause injury or death.



ATTENTION!

Not following this note can cause permanent damage to the analyzer.



NOTE!

Usefull information

1.3 Intended use

Do not use the Wohler A 400 Flue Gas Analyzer for any other use than set out in this manual.

The analyzers should be used indoors only.

Use the Wohler A 400 for flue gas analysis of heating appliances, ambient CO and manifold pressure tests only.

1.4 Components

Model	Components
Wohler A 400	Integrated flexible probe
	Heavy duty carrying case
	Batteries

	Replacement filters
Model	Componenets
Wohler A 400 ^{PRO}	Probe and hose assembly
	Heavy duty carrying case
	Batteries
	Replacement filters
Model	Componenets
Wohler A 400 L	Probe and hose assembly
	Plastic Case
	Batteries
	Replacement filters

Available sets may include:

- rechargeable batteries and recharger
- Wohler TD 600 high speed thermal printer
- Wohler RP 72 Soot Pump
- Ambient temperature probe 280

1.5 Transport



ATTENTION!

The analyzer should be transported in the original carrying case only!

To prevent damage to the analyzer use the original carrying case when transporting.

The carrying case can be purchased separately.

1.6 Manufacturer

Wöhler Messgeräte Kehrgeräte GmbH

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Bad Wünnenberg, Germany, 33181

1.7 North American Headquarters

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Email info@wohlerusa.com

www.wohlerusa.com

2 Safety advice

**WARNING!****Avoid electrical hazards:**

Never use the analyzer and probes to measure on or near live parts.

**ATTENTION!**

Operate the measuring instrument only within the parameters specified in the Technical data.

**ATTENTION!**

Never apply force.

**ATTENTION!**

Temperatures on sensors relate only to the measuring range of the sensors. Do not expose handles to any temperatures in excess of 70 °C.

**ATTENTION!**

Open the measuring instrument only when this is expressly described in the instruction manual for maintenance work.

**ATTENTION!**

Use only original Wöhler spare parts.

3 Specifications

Oxygen (O₂)	
Sensor type	electrochemical
Range	0 ... 21.0 Vol.-%
Resolution	0.1 Vol.-%
Accuracy	± 0.3 Vol.-%
Carbon monoxide (CO 4,000 ppm) (A 400, A 400^{PRO} only)	
Sensor type	electrochemical
Range	0 ... 4,000 ppm
Resolution	1 ppm
Accuracy	± 5 % f.m., absolute ± 20 ppm
Carbon monoxide (CO 10,000 ppm) (A 400 L only)	
Sensor type	electrochemical
Range	0 ... 10,000 ppm
Resolution	1 ppm
Accuracy	± 10 % f.m., absolute ± 40 ppm
Nitrogen monoxide (NO 1,000 ppm) (A 400^{PRO} only)	
Sensor type	electrochemical
Range	0 ... 1,000 ppm
Resolution	1 ppm
Accuracy	± 5 ppm (<100 ppm), else 5% of reading
Accuracy	± 2 % f.m., absolute ± 0.02 inWC

Draft / Differential pressure(PD)	
Units	inWC / psi / Pascal / mbar
Range	± 40 inWC
Resolution	0.004 inWC
Flue Gas Temperature (TS)	
Units	°F /°C
Sensor type	Thermoelement (NiCr-Ni)
Range	-4°F ... 1472°F
Resolution	0.2°F
Accuracy	32...257°F: ±4°F 257...482°F: ±6°F 482...752°F: ±8°F 252...1472°F: ±1.5%
Air Temperature (TA)	
Units	°F /°C
Sensor type	Semiconductor (Si-PTC-Ni)
Range	-4°F ... 248°F
Resolution	0.2°F
Accuracy	±2°F

Calculated Values	
Effc. / SL	efficiency and losses in accordance to ASME standards
ETA /QS	efficiency and losses in accordance to EN European standards
CO ₂ in Vol.-%	range 0 – CO ₂ max, resolution 0.1%
COc	CO air free (CO corrected)
Dew point	in °F / °C
λ / EA	theoretical air / excess air
mcond	Condensate qty. in condensing conditions
Toxication index Gi	CO/CO ₂
Power supply	4 AA rechargeable batteries or 4 AA disposable batteries 1.5 Volt.
Current	150 mA (normal backlight setting), Standby current 44 μA
Voltage	Battery: 4.0 to 7.2 V, standard 4.8 V
Storage temperature	-4 °F to + 122 °F
Operation temperature	41 °F to 104 °F to meet specifications
Weight	1.4 lbs / 640 g
Dimensions	8 x 3.3 x 8.7 inch (w/o probe) 29.1 x 3.3 x 8.7 inch (with flexible probe)
Wohler A 400 ^{PKO} : probe hose length	1700 mm / 67 inch
Wohler A 400: flexible probe length	540 mm / 21 inch

4 Component Explanation



Figure 1: Overview Wöhler A 400^{PRO},/A 400 L

Component Explanation

- 1 Probe and hose assembly
- 2 Color display
- 3 Scroll and Zoom keys
- 4 Enter and ON/OFF key
- 5 ESC key
- 6 IR printer interface
- 7 Connection for ambient air temperature sensor
- 8 Connection for charger
- 9 Battery compartment
- 10 Connection for handloop
- 11 Connection for manifold pressure
- 12 Heatexchanger and watertrap control window
- 13 Filter cover
- 14 Integrated magnetic holders

4.1 Models

The Wohler A 400 Flue Gas Analyzer is available in two different designs:

- Wohler A 400, see figure 2
- Wohler A 400^{PRO}, see figure 1

The probe and hose design makes the difference. The Wohler A 400^{PRO} is equipped with a traditional probe and hose assembly, while the Wohler A 400 comes with a unique flexible probe tube attached directly to the analyzer.

The Wohler A 400 flexible probe tube is of exceptional help in hard to reach measurement openings.



Figure 2: Wohler A 400 with flexible probe



NOTE!

Do not snap the flexible probe tube to ensure maximum lifetime. Figure 2 shows the maximum bending radius of 4 inches (10 cm) which must not be exceeded.

4.2 Functions



Figure 3: Gas sampling path

The stack gas is sampled through the probe into the base unit (see also page 36).

The four step filter conditioning consists of:

- The first step is the heat exchanger. Most of the water moisture and particles will be removed from the sample.
- The second step is the cotton filter to remove residues of water and small particles left in the sample.
- The third step is the water stop filter. This filter will not allow any kind of moisture to pass. The filter will clog automatically in contact with water to protect all sensors.
- The fourth step is the LT-filter. This chemical filters removes all harmful gas components.

The sample passes all sensors and leaves the analyzer behind the battery compartment.

All filters are electronically surveyed and a message will indicate the need for replacement. The filter light additionally indicates the operator to change the filters.

4.3 Display and key setup

The Wohler A 400 has a color 2.4" display (Figure 4). The OLED-technology allows reading the display from almost any angle of view.

Four keys are available below the display to operate the Wohler A 400.



Figure 4: Display and keys

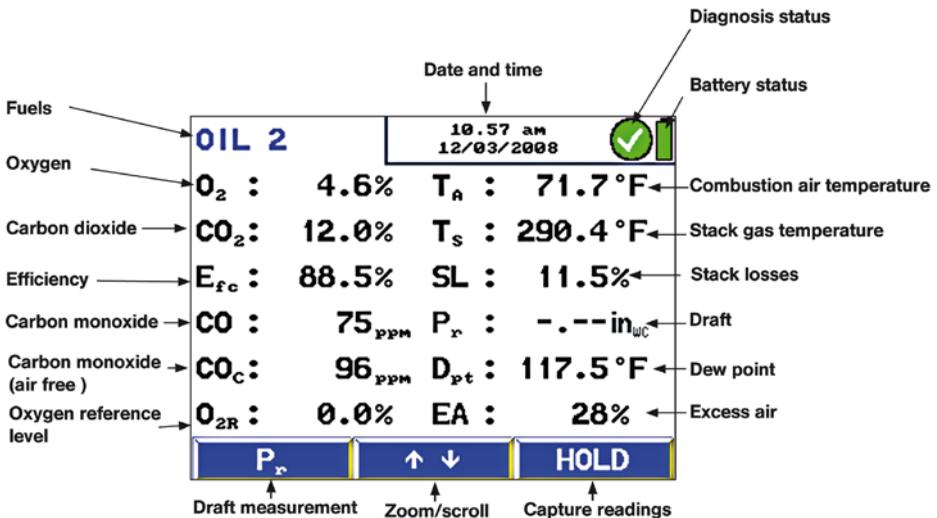


Figure 5: Display details

The display is divided into a status, a menu and a readings segment.

The currently selected fuel, date and time, system diagnosis status and battery level are shown in the status segment.

The readings segment displays the readings or the menu items.

The menu segment shows three soft keys.

5 Getting started

5.1 Check battery status



Figure 6: Battery change

Check the battery status. When the analyzer is switched on, the battery indication is displayed in the upper right hand corner of the screen. A fully charged set of batteries is shown as a solid green battery symbol (refer to chapter 5.1). An empty red symbol indicates discharged or empty batteries.



WARNING!

Incorrect use of batteries can cause injury!

Do not expose batteries to fire or high temperatures, that will cause danger of explosion!
Liquids can pore out of the batteries due to mistreatment. Never touch the liquid. If you got in contact to the liquid remove it with water and see your doctor as soon as possible.



WARNING!

Risk of electrical shock!

Never touch the recharger with wet hands!
Protect the recharger against water and moisture!
Do not unplug the recharger by pulling the cable!
Do not use the recharger when the voltage requirements of the recharger and the supply do not match!

The batteries can be recharged even while they are located in the analyzer. During the charging process, it will not be possible to work with the analyzer.

**ATTENTION!**

Ensure rechargeable batteries are equipped in the analyzer before charging. Never try to charge disposable batteries! Use 4 AA rechargeable or disposable batteries only.

How to charge the batteries:

- Before you plug the recharger into the outlet, connect it with the analyzer.

Standard AA rechargers can be used for external charging when the batteries are not located in the analyzer.

- To remove the batteries from the analyzer open the battery compartment cover as shown in figure 12.

Recharging empty batteries can take up to 3 hours.

**NOTE!**

To ensure maximum capacity use batteries of same age and condition only. Always replace a full set of 4 batteries when necessary.

5.2 Connect the probe and hose assembly (Wohler A 400^{PRO} only)

The Wohler A 400^{PRO} comes with a replaceable probe and hose assembly, see Figure 7 and Figure 8.

How to remove the probe and hose assembly:

1. Unplug the thermocouple connector (Figure 7).
2. Remove the hose from the analyzer (Figure 8)



Figure 7: Step 1



Figure 8: Step 2

5.3 Tightness test

A tightness test can only be performed with the probe and hose assembly connected properly and the analyzer switched off.

Follow the steps below to perform a tightness test:

! ATTENTION!

Never compress the rubber ball when connected to the probe, it can cause permanent damage to the pressure sensor.

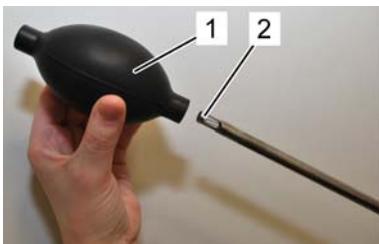


Figure 9: rubber ball

1. Compress the rubber ball (Figure 9 /1).
2. Connect the rubber ball (Figure 9 /1) to the probe end (Figure 9 /2).
3. Do not touch the rubber ball anymore.

If the rubber ball does not inflate by itself or inflates very slowly the tightness test is passed.

5.4 Manifold pressure connector



Figure 10: Auxiliary pressure port

To measure the manifold pressure the Wohler A 400 is equipped with an auxiliary pressure port. The auxiliary pressure port is located left of the display (Figure 10/1) The maximum pressure range is ± 40 inWC or ± 110 hPa.

How to perform a manifold pressure test see chapter 5.4.5.

6 Using the Analyzer

6.1 Key functions

Holding the right button pressed will always turn the analyzer ON or OFF.

When the user is holding the left button pressed (escape), the analyzer will always turn back to the main menu.

The click functions of the four keys of the analyzer can change depending on the available menu options.

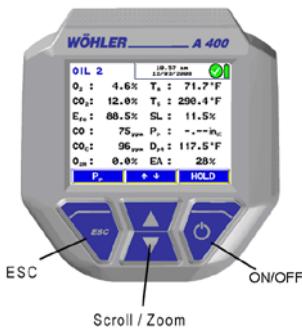


Figure 11: Display/Keys

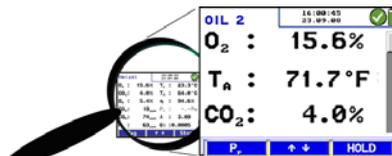


Figure 12: Zoom feature

The Wohler A 400 provides a Zoom function for all combustion readings. Hold the up or down key pressed to zoom in or out. You can scroll the readings by clicking the up or down keys.

The Wohler A 400 is equipped with integrated magnetic holders. The magnetic holders will fix the analyzer on any magnetic material surface. The magnetic holders are located in the stand and left and right of the display.



ATTENTION!

Do NOT place the analyzer unsecured, it can fall down and get damaged!

During a combustion test either

- hold the analyzer in one hand
- or
- place it with the magnetic holder to any appropriate surface.

6.2 Turning the analyzer ON

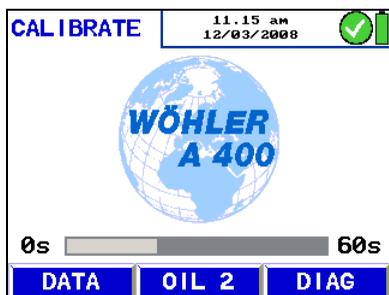


Figure 13: Self check and calibration

Hold the ON/OFF key pressed for about 3 seconds to turn ON the analyzer. The analyzer will automatically start with a 60 second self check and calibration.



NOTE!

Do not put the probe into the stack while the analyzer is performing the self check and calibration.

After the self check and calibration the analyzer is ready to start a test.

The pressure sensor will automatically be zeroed during self check and calibration.

During self check and calibration the operator can chose the following options in the menu:

Option 'DATA'

Click the left key to enter the data management screen.

Option 'OIL 2'

This option shows the currently selected fuel. To change the fuel click the up or down key. You can change the fuel at any time after self check and calibration by entering the menu.

Option 'DIAG'

Click the right key to enter the analyzers self diagnosis mode.

6.3 Performing a combustion efficiency test

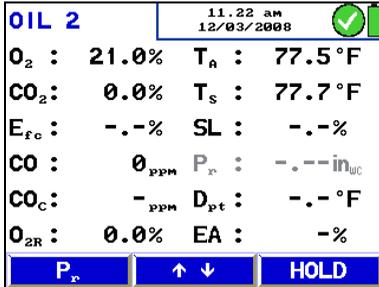


Figure 14: Combustion test screen RUN mode

Upon conclusion of self check and calibration procedure the analyzer will display the main combustion efficiency test screen.

You are ready to insert the probe into the stack and begin your test now.



NOTE!

Do NOT put the probe in an elbow. Place the probe in the center of a straight piece of smoke pipe as close to the heating appliance as possible. Never take a test between the draft regulator and the chimney.

When you have adjusted the burner to achieve the desired combustion test result, press the 'HOLD' key. The menu will change as shown in Figure 15 and indicates that the analyzer has now captured these test results for printing or storing see 5.4.

The menu options during a combustion test are as follows:

- Option '↑↓' (center keys): hold the up or down key pressed to zoom in or out. You can scroll the readings by clicking the up or down keys.
- Option 'HOLD' (right key): Capture the current readings and turns the analyzer to 'HOLD' mode.
- Option 'P_r' (left key): Captures all current readings and performs a draft test immediately

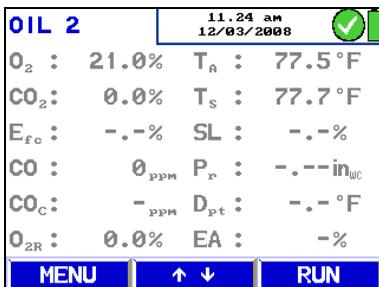


Figure 15: Combustion test screen HOLD mode

The menu options during 'HOLD' mode are as follows:

- Option 'MENU' (left key): click the left key to enter the main menu screen, see 5.4.
- Option '↑↓' (center keys): hold the up or down key pressed to zoom in or out. You can scroll the readings by clicking the up or down keys.
- Option 'RUN' (right key): Clears all captured readings and turns the analyzer into 'RUN' mode.

6.4 Main menu

When the analyzer is in 'HOLD' mode the following menu options are available:

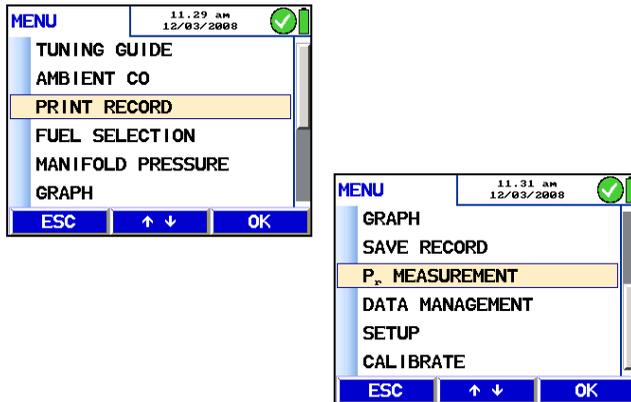


Figure 16: Main menu

6.4.1 Option 'TUNING GUIDE'

The option 'TUNING GUIDE' offers an exceptional advanced guidance to the technician to properly adjust the burner.

All combustion test related readings are presented in a graph over the excess air. The current reading is marked with a red box and any former reading is tracked with a green line.

The 'Green Zone' indicates the best combustion performance excess air range of the burner. The range is user changeable for any selected fuel.

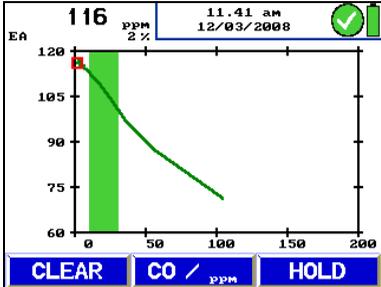


Figure 17: Tuning Guide CO

Figure 17 shows, that the CO content in the flue gas increases significantly when the available excess air decreases. At a very poor excess air level of 2% the burner generates 116 ppm CO.

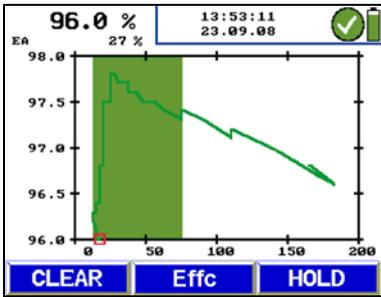


Figure 18: Tuning Guide Efficiency

Figure 18 shows, that for this burner the best efficiency reading of 97.8% will be reached at an adjusted excess air level of 25%.

6.4.2 Option 'AMBIENT CO'

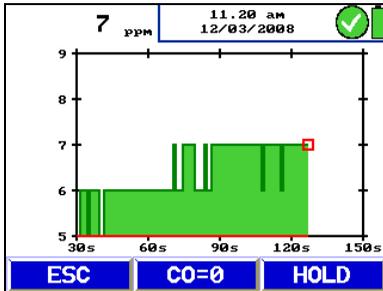


Figure 19: Ambient CO test 'RUN' mode

The option 'AMBIENT CO' offers a graphical assisted ambient CO test.

The current ambient CO concentration is shown over the elapsed measurement time. Figure 19 shows an 'Ambient CO' test over a time period of 120 seconds and the current CO level is 7 ppm. When clicking 'HOLD' the current graph and the last CO reading is captured to be printed or stored.

The menu options during 'RUN' mode are as follows:

- Option 'ESC' (left key): click the left key to exit without performing an 'AMBIENT CO' test and return to the main menu.
- Option 'CO=0' (↓↑ center keys): click either up or down key to zero-out the CO sensor offset reading.
- Option 'HOLD' (right key): click the right key to capture the current readings and turn the analyzer to 'HOLD' mode.



NOTE!

Due to temperature effects and aging of the CO sensor it is possible that the 0 ppm offset level changes. Check regularly in clean air that the ambient CO level is reading zero. If the reading is not zero in clean air, click the 'CO=0' key to zero-out the readings.

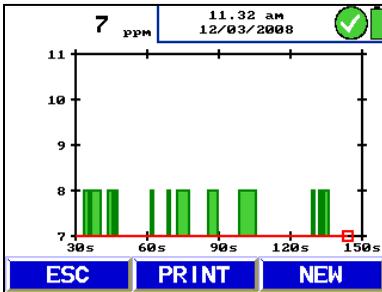


Figure 20: ambient CO test 'HOLD' mode

The menu options during 'HOLD' mode are as follows:

- Option 'EXIT' (left key): click the left key to save the 'Ambient CO' test and return to the main menu.
- Option '↓↑' (center keys): click either up or down key to printout a full graphical report on your Wohler TD 600 thermal printer. To print a complete 'AMBIENT CO' test takes about 2 minutes.
- Option 'NEW' (right key): click the right key to clear the graph and all captured readings and turn the analyzer into 'RUN' mode.

6.4.3 Option 'PRINT RECORD'

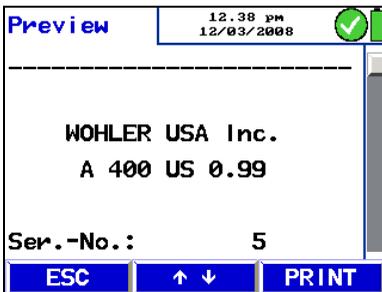


Figure 21: Print preview

Once you have completed your combustion test you can create a printout by selecting the 'PRINT RECORD' option in the main menu.

The analyzer will present a print preview on the display. You can check the information by scrolling through the entire print out with the up and down keys. To finally get a hard copy of the report click on 'PRINT' at any time.

Click the 'ESC' key to exit the print preview and return to the main menu screen.



NOTE!

The print preview display has a scroll bar to the right to indicate the current position in the print out.

The menu options in the preview screen are:

- Option 'ESC' (left key): click the left key to exit and return to the main menu screen.
- Option '↓↑' (center keys): click either up or down key to scroll up or down in the preview.
- Option 'PRINT' (right key): click the right key to start the print out.



Figure 22: Printing in progress

Make sure you point the electronic eyes of the analyzer, located in the handle, at the electronic eye of the printer during print out.

If you desire multiple copies of the results click on 'PRINT' as above for an additional copy.

6.4.4 Option 'FUEL SELECTION'

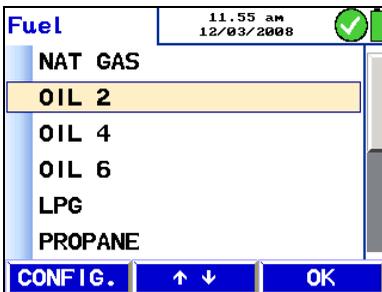


Figure 23: Fuel selection

To change the fuel you are testing you have to enter to the option 'FUEL SELECTION' in the main menu screen.

The menu options in the 'FUEL SELECTION' screen are:

- Option 'CONFIG' (left key): click the left key to enter the fuel customization screen for the currently selected fuel.
- Option '↑↓' (center keys): click either up or down key to scroll your selection up or down.
- Option 'OK' (right key): click the right key to change the fuel and return to the combustion test screen.

! ATTENTION!

Changing the preset fuel specification will change the results of your combustion test. Make sure your fuel is not available in the list of preset fuels when you modify a fuel.

Fuel def.		12.36 PM 12/03/2008	
Name	:	OIL 2	
O ₂ ref	:	0.0 %	
CO ₂ max	:	15.4 %	
A ₂	:	0.6800	
B	:	0.0070	
K	:	0.94	
EXIT		↑ ↓	

Figure 24: customized fuel

The fuel customization screen allows you to change the specifications of any fuel. You can change the name of the User defined fuel only. Fuels are defined by:

- **Aggregate**
- **O₂ref** (Oxygen reference level)
- **CO₂max** (maximum CO₂ level)
- **A₂** (fuel factor)
- **B** (fuel factor)
- **K** (Lower Heating Value / Higher Heating Value)
- **EA min** (left end of green zone in the 'Tuning Guide')
- **EA max** (right end of green zone 'Tuning Guide')



NOTE!

In the main menu 'SETUP' option you can set all fuel specifications back to the factory default settings.

All solid fuels allows you to enter a specific moisture content to perform a correct efficiency calculation.

6.4.5 MANIFOLD PRESSURE

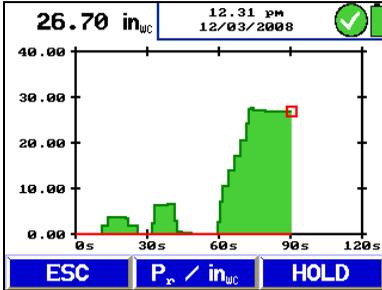


Figure 25: Manifold Pressure RUN mode screen

To perform a manifold pressure test you have to enter the option 'MANIFOLD PRESSURE' in the main menu screen. Make sure you connect an appropriate hose to the auxiliary pressure connector part.

The menu options in the 'RUN' mode screen are:

- Option 'ESC' (left key): click the left key to exit and return to the main menu screen.
- Option '↑↓' (center keys): click either up or down key to change the pressure unit between inWC, psi, Pa, hPa, mbar. Hold up or down key pressed to zero-out the pressure sensor.
- Option 'HOLD' (right key): click the right key to capture the current readings and turn the analyzer to 'HOLD' mode.



NOTE!

To zero-out the pressure sensor during a manifold pressure test, disconnect any hoses from the analyzer and hold the up or down key pressed for about 3 seconds.

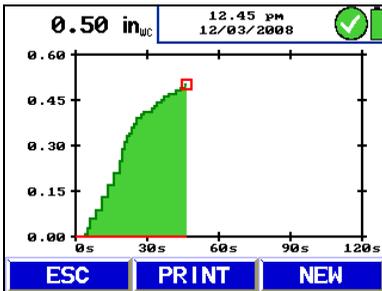


Figure 26: Manifold Pressure HOLD mode screen

The menu options in the 'HOLD' mode screen are:

- Option 'EXIT' (left key): click the left key to exit the 'MANIFOLD PRESSURE' test and return to the main menu.
- Option '↑↓' (center keys): click either up or down key to print out a full graphical report on your Wohler TD 600 thermal printer. To print a complete 'MANIFOLD PRESSURE' test takes about 2 minutes.
- Option 'NEW' (right key): click the right key to clear the graph and all captured readings and turn the analyzer into 'RUN' mode.

6.4.6 Option 'GRAPH'

The 'GRAPH' mode is used to produce a graph of any measured or calculated value shown on the combustion test screen. This function is useful for observing a trend of a measured value over a 120 second time period. To start the 'GRAPH' mode select the option in the main menu.

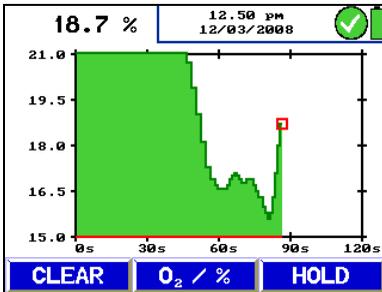


Figure 27: GRAPH mode screen

The menu options in the 'RUN' mode screen are:

- Option 'CLEAR' (left key): click the left key to clear the current graph and restart.
- Option 'O₂ / %' (center keys): click either up or down key to change the value to be observed.
- Option 'HOLD' (right key): click the right key to capture the current graph and readings and turn the analyzer to 'HOLD' mode.

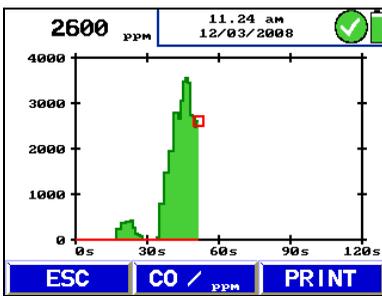


Figure 28: GRAPH mode screen

The menu options in the 'HOLD' mode screen are:

- Option 'ESC' (left key): click the left key to exit the 'GRAPH' mode and return to the main menu.
- Option 'CO / ppm' (center keys): click either up or down key to change the value to be observed
- Option 'PRINT' (right key): click the right key to printout a full graphical report on your Wohler TD 600 thermal printer.

6.4.7 Option 'SAVE RECORD'

The Wohler A 400 is capable of saving up to 100 customer records. A customer record consist of

- Customer Name and ID
- Combustion test
- Manifold pressure test
- Ambient CO test

To save a complete customer record select the 'SAVE RECORD' option in the main menu screen.

The available menu options are:

- Option 'PROCEED' (left key): click the left key to confirm new customer name and ID to be set up in the analyzers memory.
- Option '↓↑' (center keys): click either up or down key to navigate the cursor.
- Option '→' (right key): click the right key to edit information.

Figure 29: SAVE RECORD

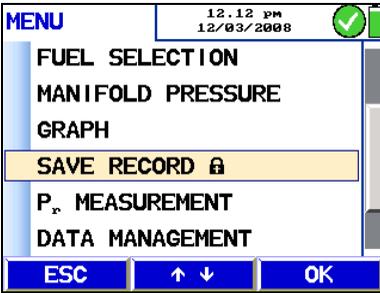


Figure 30: SAVE RECORD, lock symbol

The lock symbol behind the 'SAVE RECORD' option indicates that the customer record is saved.

6.4.8 Option 'PR MEASUREMENT'

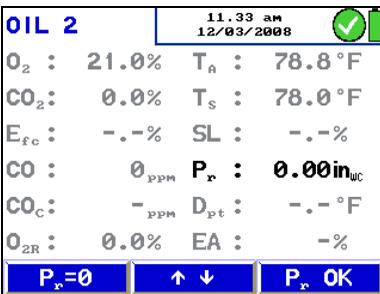


Figure 31: PR Measurement

To enter the draft measurement the Analyzer offers two different options. The first one is described in section 5.3 during a combustion test. The second method to perform a draft measurement is to select in the main menu the option 'P_r MEASUREMENT'. For draft and differential pressure the same designator P_r is used.

The available menu options are:

- Option 'P_r=0' (left key): click the left key to zero-out the pressure sensor.
- Option '↑↓' (center keys): no function.
- Option 'P_r OK' (right key): click the right key to capture the current pressure reading and set the analyzer into HOLD mode.



NOTE!

When necessary to rezero the pressure sensor the probe **MUST NOT** be in the stack.

6.4.9 Option 'DATA MANAGEMENT'



Figure 32: DATA MANAGEMENT

Select the 'DATA MANAGEMENT' option to enter the data management screen.

The data management allows to:

- Preselect a customer
- Set up a new customer
- Recall saved information
- Print saved information
- Delete customer records

Delete all customer records. Use the keys to navigate through the menu.

6.4.10 Option 'SETUP'

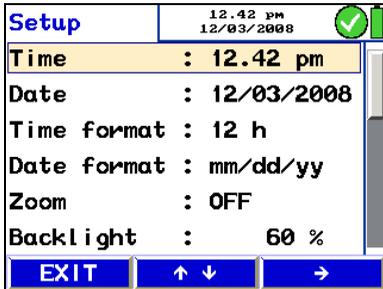


Figure 33: Setup option

Select the option 'SETUP' to enter the main setup menu. Use the keys to navigate through the menu.

- Option 'Time'
Change the current time of the analyzers internal clock.
- Option 'Date'
Change the current date of the analyzers internal calendar.
- Option 'Time format'
Select 12h or 24h mode.
- Option 'Date format'
Select the date notation month/day/year or day.month.year.
- Option 'Zoom'
Switch the Zoom mode for the combustion test screen on or off.
- Option 'Backlight'
Change the brightness of the display.

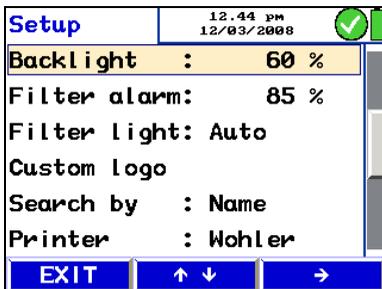


Figure 34: Settings

- Option 'Filter alarm'
Set the filter load threshold in % before the analyzer will message a warning to change the filters. When the 'Filter light' option is set to Auto the condensate trap will be illuminated by exceeding the filter load threshold. Lower the % value to receive a warning message earlier.
- Option 'Filter light'
Select the filter light mode between Auto, On or Off. In Auto mode the filter light will illuminate when the filter load exceeds the 'Filter alarm' threshold set above.
- Option 'Custom logo'
Modify the first six lines of the print out to customize your combustion test report. Use this feature to put in your company information.
- Option 'Search by'
Change the sort order of the saved records between customer Name or ID (Number).
- Option 'Printer'

When you are not using the Wohler TD 600 high speed thermal printer change this option to 'Other'. The Analyzer will then print out in a slow HP printer format.

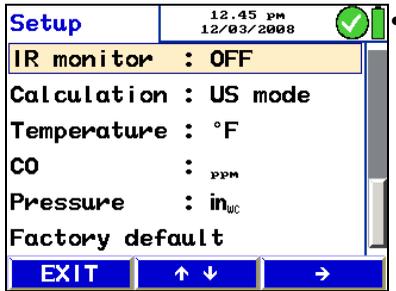


Figure 35: Settings

Option 'Calculation'

Change the combustion efficiency calculation between the North American US mode (ASME) or the European EN mode.

When selecting EN mode two more readings are displayed on the combustion test screen.

m_{cond} Amount of condensate

GI Giftindex CO/CO₂

The calculation of the combustion efficiency is different between EN and US mode. To identify the selected mode the designators for efficiency and losses changes.

US mode:

Effc Combustion Efficiency

SL Stack losses

EA Excess air

EN mode:

η Combustion efficiency

QS Stack losses

λ theoretical air

- Option 'Temperature'
Change the temperature unit between °F and °C
- Option 'CO'
Change the Carbon monoxide unit between ppm and mg/m³
- Option 'Pressure'
Change the pressure unit between
inWC inch water column
psi pounds per square inch
Pa Pascal
hPa Hectopascal
mbar millibar
- Option 'Factory default'
All settings will be set to factory default except the sensor calibration settings.

- 6.4.11 Option 'CALIBRATION'** To enter the calibration menu select the option 'CALIBRATION' in the main menu.
This option allows to digitally calibrate all sensors.

**NOTE!**

The calibration of the analyzer is allowed to trained personnel ONLY. Please contact Wohler for more information.

Please refer to section 7.4.3.

6.5 Turning OFF the analyzer

To turn off the analyzer depress and hold the ON/OFF key. The analyzer will begin a three second countdown to shutdown.

**NOTE!**

Releasing the key at any time during the three seconds countdown to shutdown will result in the analyzer staying on and returning to the combustion readings screen

**ATTENTION!**

Do NOT switch off the analyzer before purging the CO sensor below a reading of 30 ppm. Continuously turning off the CO sensor with high CO levels can cause damage to the sensor.

7 Troubleshooting



Error messages and self diagnosis problems are displayed in the combustion test screen status line by the left symbol.

How to react properly is listed below.

Error message	Possible reason	Solution
'Batteries low!'	Disposable or rechargeable batteries are empty.	Replace or recharge batteries.
'O ₂ sensor Service' 'CO sensor Service'	Probe in stack during self test and calibration	Restart Analyzer and run self test and calibration with probe in clean air.
	broken or discharged sensor	Replace sensor or send analyzer to Wohler certified service station
'Check filters!'	Filters are wet or loaded with particles	Remove condensate and replace all filters
'CO overload!'	CO concentration is higher than 4000 ppm	Remove probe from stack immediately and purge the sensor.
'Temp. failure' A 400	broken thermocouple	Return analyzer to Wohler certified service station
'Temp. failure' A 400 ^{PRO}	Thermocouple is not connected	Check the plug of the thermocouple connected correctly.
	broken thermocouple	Replace probe
	analyzer is broken	Return analyzer to Wohler certified service station

8 Maintenance

Proper operation of the Wohler A 400 requires regular maintenance.

8.1 Maintenance work

Interval	Maintenance work
After every combustion test	Remove condensate and water from the condensate trap
	Replace cotton filter when wet or dirty
	Replace Water Stop filter when clogged
After every working day (only A 400 ^{PRO} with Flexprobe with hose)	Remove condensate from the hose and let the hose dry.
Every 12 months	Return analyzer for annual check and calibration to a Wohler certified service station

8.2 Removal of condensate



Figure 36: Condensate removal



ATTENTION!

Do not use the analyzer while its temperature is significantly lower than the ambient air temperature. High amounts of condensate can cause permanent damage to the sensors.

For Removal of condensate after every combustion test follow the steps below:

1. Remove filter cover and filters.
2. Hold analyzer upside down to drain condensate (see Figure 36)

Replace cotton filters regularly when wet.

8.3 Safety features and maintenance advice

8.3.1 Filter light

For optimum protection the analyzer is equipped with a water stop filter that seals off as soon as condensate or water or dust penetrates into the gas way behind the cotton filter. The pump operation will become heavier or comes to a complete stop if the filter begins to seal off. The electronic filter diagnosis monitors the filter load continuously and advises the change of the filters on the display. A filter light will illuminate the condensate trap to easily check the status and load.

The water stop filter can be dried and reused if it does not show any visible dust penetration. To exchange the water stop filter simply attach a new one to the filter holder and put it back in.

8.3.2 LT-filter

The gas way of the Wohler A 400 is designed for an extra long lifetime of the sensors.

A special filter filled with LT-pellets is built into the gas way to extend sensor life. If the color of the LT-pellets turns to yellow it needs to be replaced.

Using the analyzer for regular combustion tests only, the LT-pellets filter does not need to be replaced before the sensor life expires.

To replace the LT-pellets filter see section 7.4.3.

8.4 Maintenance and change of sensors

8.4.1 Cleaning the gas way

To clean the gas way follow the steps below:

1. Turn OFF the Analyser.
2. Remove black rubber filter cover.
3. Pull water stop filter with cotton filter holder out.
4. Pull off the cover of the cotton filter holder
5. Replace cotton filter.
6. Replace water stop filter when necessary.
7. Clean filter holder with water.
8. Put water stop filter and cotton filter holder back in.



Figure 37: Opened filter cover



Figure 38: Separate filter components

8.4.2 Sensors

The life of the measuring sensors will be determined by numerous outside parameters such as the care provided for the analyzer (removal of condensate), the frequency of use and regular maintenance. This explains why the average life of measuring sensors will be determined by specific experience.

Average sensor life expectancy:

O₂ sensor: 4 years

CO Sensor: 4 years

The sensors are field replaceable and can be changed by the customer.

8.4.3 Sensor diagnosis and change

The Wohler A 400 has an advanced electronic self diagnosis program. To enter the diagnosis screen click 'DIAG' during self check and calibration.

The diagnosis screen shows:

- Firmware version
- Serial number
- Sensor status and date of installation
- Accumulated CO overload time
- Current filter load in %
- Total operation time
- Total measurement cycles
- Date of last calibration
- Date of manufacturing

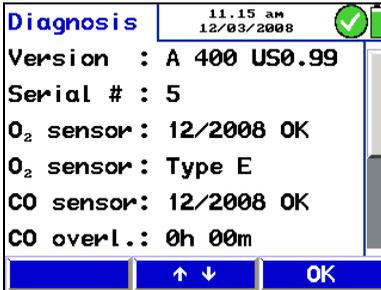


Figure 39: Diagnosis screen OK

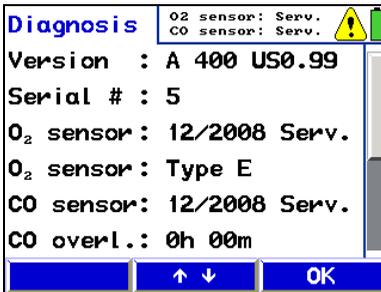


Figure 40: Diagnosis screen for service request



Status: OK



Status: Service



Zeroing sensor

Figure 41: Status icons

The list below shows the possible diagnosis feedback:

- Analyzer status: green check mark icon indicates proper operation. Yellow sign icon indicates a problem.
- 'OK' or 'SERVICE' for all sensors
- Zeroing pressure sensor: during zeroing of the pressure sensor the blue icon appears on the screen. Do not expose any differential pressure to the analyzer now.



Figure 42: Change a sensor

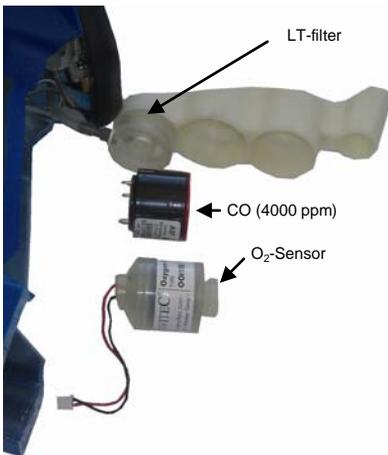


Figure 43: Position of sensors

How to change a sensor:

1. Turn off the analyzer.
2. Remove the batteries.
3. Remove the two screws, see Figure 42, picture 1.
4. Remove the sensor cover.
5. Disconnect the sensor cable.
6. Pull the sensor out of the holder.
7. Install new sensor, check polarity.
8. Reconnect the sensor cable.
9. Reposition sensor holder.
10. Reposition sensor cover.
11. Lock sensor cover with both screws.
12. Install batteries.



ATTENTION!

Do NOT pinch any cable or wiring!

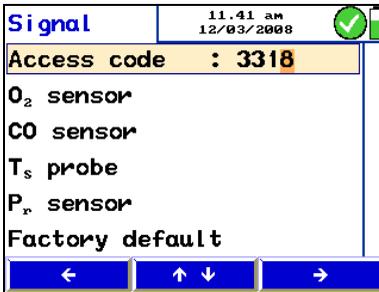


Figure 44: Access code entry

13. Turn on the analyzer.
14. Enter the calibration menu.
15. Enter Code '3318'.
16. Always change information for the replaced sensor the following way:
 - O₂ sensor: date and model.
 - CO sensor: date and calibration data.

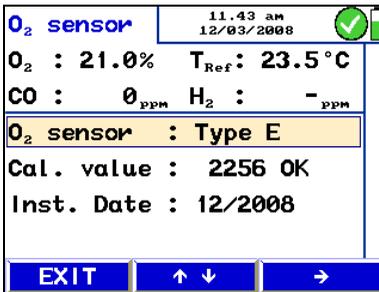


Figure 45: O₂-sensor calibration

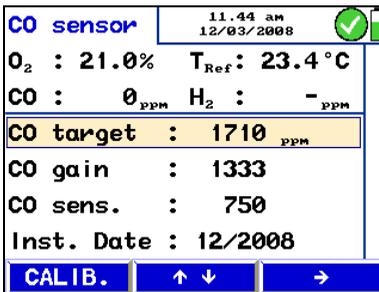


Figure 46: CO-sensor calibration

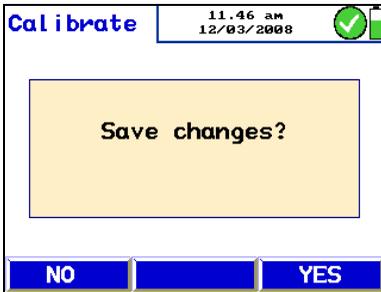


Figure 47: Confirm to save changes

17. Exit calibration mode and confirm changes.
18. Run self check and calibration two times by turning the analyzer on and off.
19. Enter diagnostic menu and check status and data of the new sensor

9 Warranty and Service

9.1 Warranty

Each Wohler A 400 Flue Gas Analyzer will be tested in all functions and will leave our factory only after extensive quality control testing. The final control will be recorded in detail in a test report and delivered with any unit.

If used properly, the warranty period for the Wohler A 400 and Wohler A 400^{PRO} will be 4 years from the date of sale. Not covered by the warranty are components subject to wear and the thermocouple, the flexible probe tube and the batteries.

This guarantee does not include the costs for transport and packing material in case of repair.

Service by non authorized personnel or making modifications to the analyzer voids any warranty.

9.2 Service

Wohler USA has built our reputation on excellence in customer service. Should you ever need calibration or service simply go to our website www.wohlerusa.com. Click on the service icon on the homepage. Fill out the RMA form and hit submit. We will arrange for return shipping. Your analyzer will be serviced and returned to you within 72 HOURS.

10 Accessories

Printer

Wohler TD 100 high speed thermal printer	p/n 4160
Printer paper, 10 roles	p/n 4145

Carrying case

Heavy-duty carrying case Wohler A 400	p/n 3345
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Probes

Air temperature Probe 280	p/n 6019
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Extras

Wohler RP 72 Soot Test Pump	p/n 9152
Rubber ball	p/n 2340

Spare parts

4 AA rechargeable batteries, 2 Ah	p/n 9407
Water stop filter Wohler A 400, 3 pcs.	p/n 9621
Cotton filter, short, 25 pcs.	p/n 4286

Sensors

O ₂ Sensor A 400 field replaceable	p/n 3354
CO Sensor A 400 0-4,000ppm field replaceable	p/n 3368