

## Heater diagnosis - Carbon Dioxide (CO<sub>2</sub>) Measurement Setting for Heater Series: **Thermo plus | Thermo S**

### CO<sub>2</sub> Measurement

A commercially available combustion gas analyzer (exhaust gas measuring device) is required for the CO<sub>2</sub> measurement.

The CO<sub>2</sub> content of the exhaust gas must be measured and, if necessary, adjusted by changing the speed of the burner fan motor:

- After repairs to the burner.
- In the event of irregular combustion, smokey and/or sooty combustion and unusual combustion noises.
- In the event of excess soot build-up on the inside of the heat exchanger or other components as part of a functional test.
- After changing the fuel nozzle.
- After readjusting the pump pressure.
- For heating operation 1000 meters (3,280 ft.) above sea level (NHN).
- In the event of changes to the optional, combustion air intake or exhaust pipe.
- When using air-side applications other than splash guards (20818\_) or grilles (20819\_) and when using non-SPHEROS intake or exhaust pipe applications.

### NOTE

An **increased CO<sub>2</sub>** value and/or smoky, sooty combustion is caused by

- a) Insufficient supply of combustion air. This is caused by:
  - Use of supply air or exhaust-side applications that restrict the supply of air into or the removal of exhaust gas out of the heater
  - Excess soot built-up inside the heat exchanger
  - High operating altitude
  - insufficient air supply at the installation location of the heater
- b) Excessive fuel supply. This is caused by
  - Incorrect nozzle
  - Increased pump pressure
  - Closed or partially closed fuel return line
  - Cold fuel (high viscosity) with warm intake air

A **reduced CO<sub>2</sub>** value and a strong-smelling combustion are the result:

- a) Excessive supply of combustion air. This is caused by
  - Excessive fan speed
  - Incorrect combustion chamber
- b) Insufficient fuel supply. This is caused by
  - Incorrect nozzle
  - Reduced pump pressure

- Air bubbles and/or leaks in the fuel supply line or the fuel pump
- Warm fuel (low viscosity) with cold intake air

The procedure for setting the CO<sub>2</sub> content is specified by the program sequence of the Spheros Diagnose Thermo Test (hereinafter referred to as DTT diagnosis).

## NOTE

An **increased** flue/ exhaust gas temperature may indicate a sooted heat exchanger (see Tab. 1).

16 kW	23 kW	30 kW	35 kW
300°C	370°C	400°C	430°C

Tab. 1: Increased exhaust gas temperatures

## Requirements for CO<sub>2</sub> measurement and setting

1) Before measuring / adjusting, ensure that:

- The inside of the heat exchanger is clean and free of soot.
- Always remove the combustion chamber to clean the heat exchanger.
- The intake and exhaust applications (or air inlet and exhaust outlet) as well as the fuel lines are free flowing.

2) Before measuring and when carrying out the CO<sub>2</sub> setting, ensure that the fuel lines between the heater and the fuel tank are free and open during the entire procedure (e.g. non-return valves or electrically operated valves). Otherwise, the combustion process will be interrupted and the CO<sub>2</sub> value cannot be set.

This applies to both the fuel supply and return lines.

## NOTE

To measure the CO<sub>2</sub> content, the heater can be started by switching it on manually, whereby the measurement should only begin after approximately 2 minutes of heating operation.

It is recommended to use the DTT diagnostics and the "CO<sub>2</sub> setting" mode contained therein (see step 3 below).

## Measuring equipment / measuring device for CO<sub>2</sub>

To measure and determine the CO<sub>2</sub> values, only use calibrated measuring devices that measure CO<sub>2</sub> directly (e.g. from Brigon or KANE).

Measurement devices that measure O<sub>2</sub> (oxygen) and convert the reading into CO<sub>2</sub> are not recommended. These devices use reference data for specific fuels typical in building heating systems and not for Diesel, BioDiesel and synthetic fuels (XTL).

## NOTE

Observe the manufacturer's instructions for your CO<sub>2</sub> measuring device.

Position the sampling probe of the CO<sub>2</sub> measuring device in the center of the flue gas pipe at a distance of approx. 350 mm (12 inches) behind the exhaust gas connection (3). See fig. 1:

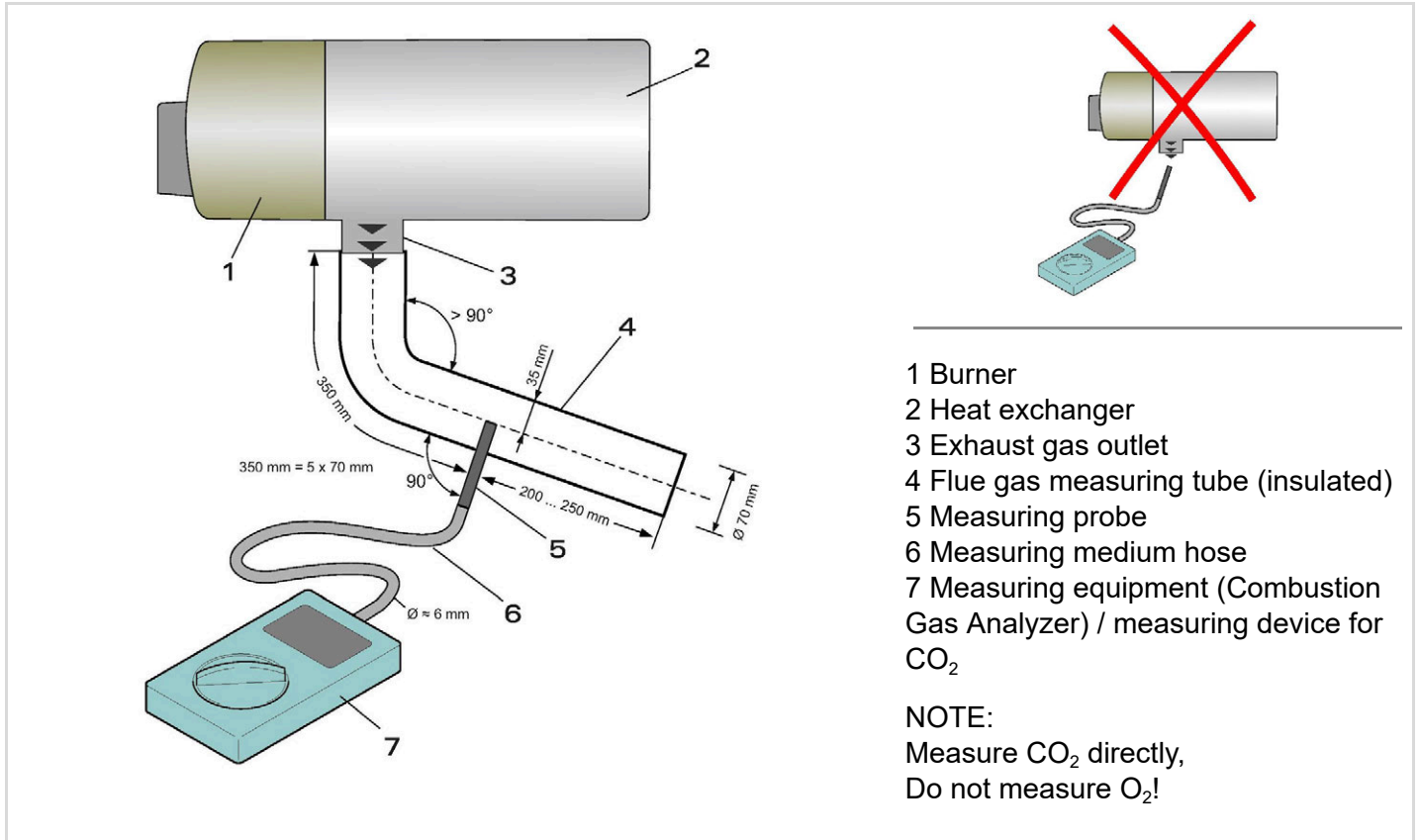


Fig. 1: Measuring the CO<sub>2</sub> content with measuring equipment / measuring device for measuring CO<sub>2</sub>

## CO<sub>2</sub> - Adjustment

Changing/ adjusting the factory-set CO<sub>2</sub> content of the exhaust gas is permissible and sometimes necessary.

If the measured CO<sub>2</sub> value is not within the specified range, the cause must first be determined, then corrected before the final CO<sub>2</sub> value adjustment.

For CO<sub>2</sub> target values, see maintenance schedule or technical data in the installation instructions.

As part of the adjustment, the speed of the burner motor must be changed so that the required CO<sub>2</sub> content is set in the exhaust gas. This can be achieved with the DTT diagnosis from Spheros.

For CO<sub>2</sub> target values, see maintenance schedule or technical data in the installation instructions.

## Setting procedure for Thermo plus and Thermo S heaters with speed control

(see following picture description)

### NOTE:

The CO<sub>2</sub> adjustment process by the DTT diagnostics takes into account that the CO<sub>2</sub> value requires a specified time to stabilize (steps 5 and 6 below) before the speed of the burner fan motor may be changed.

### NOTE:

The measurement and setting of the CO<sub>2</sub> value and the speed of the burner fan motor takes into account the application on the heater / in the vehicle and the altitude at the respective setting location (where the CO<sub>2</sub> value is measured and set).

With increasing altitude, the CO<sub>2</sub> value increases by approx. 0.1 vol-% per 100 m in altitude due to the decreasing air density. under otherwise identical conditions.

If the heater is predominantly used at a much higher altitude, the speed of the fan motor must be adjusted to the setting location.

The speed must be increased by a further 100 rpm for every 250 m increase in altitude compared to the setting location in order to compensate for the change in air density.

### Example:

A speed of 4,900 rpm was determined for a CO<sub>2</sub> value of 10 vol% at an altitude of 500 m using the air and exhaust gas application on the heater. However, the vehicle is mainly used at an altitude of 1,500 m above sea level. This means that a further +400 rpm must be added to the set 4,900 rpm at an altitude of 500 m for an altitude difference of 1,000 m.

The speed must therefore be set to 5,300 rpm for an altitude of 1,500 m so that the CO<sub>2</sub> value is also approx. 10 vol-% there due to the lower air density.

### NOTE:

An upper and lower speed limit is stored in the control unit. This is to prevent incorrect settings during service. The speed limits are displayed by the DTT diagnostics.

### NOTE:

If the CO<sub>2</sub> content cannot be set correctly, or if an unusually high speed is required, the cause must be rectified:

1. Check the burner head on the air side for damage and replace damaged parts if necessary.
2. Check air intake or exhaust gas applications for damage and obstructions.
3. Check fuel filter for restrictions and replace if necessary.
4. Replace fuel nozzle.
5. Check the pump pressure of the fuel pump and adjust if necessary.

## IMPORTANT:

If the fuel return line is closed, the fuel pump pressure will increase significantly - considerably more fuel is sprayed into the heater and the CO<sub>2</sub> value rises sharply.

Alternatively, check the pump pressure of the fuel pump:

Disconnect the fuel return line from the heater and collect fuel from the heater in a suitable container, measure CO<sub>2</sub> again.

6. Check the filter in the fuel pump for restrictions and replace if necessary.

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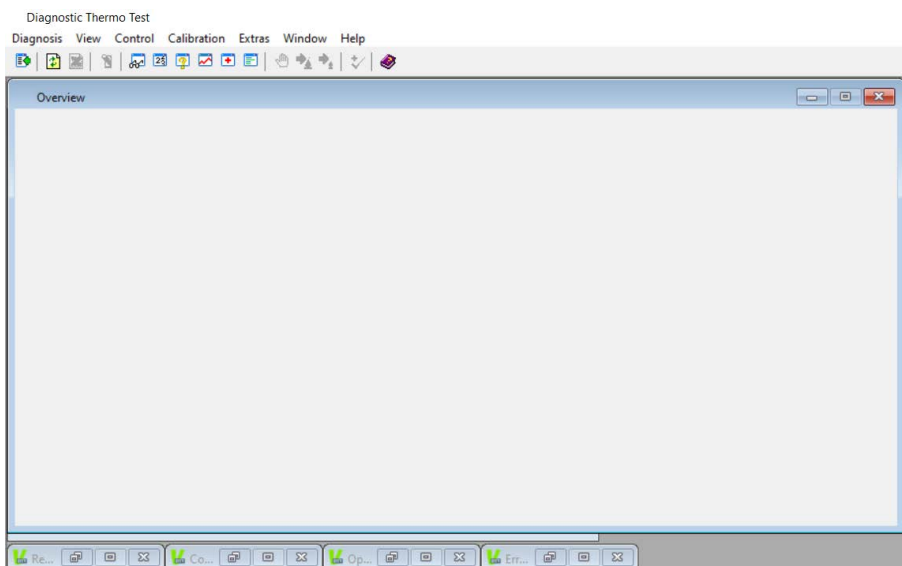
## Start DTT diagnostics and connect the heater to the diagnostics

### NOTE:

It is recommended that you download and use the latest version of the DTT diagnostics software. The latest version is available at [www.spheros.com](http://www.spheros.com) in the Download Center.

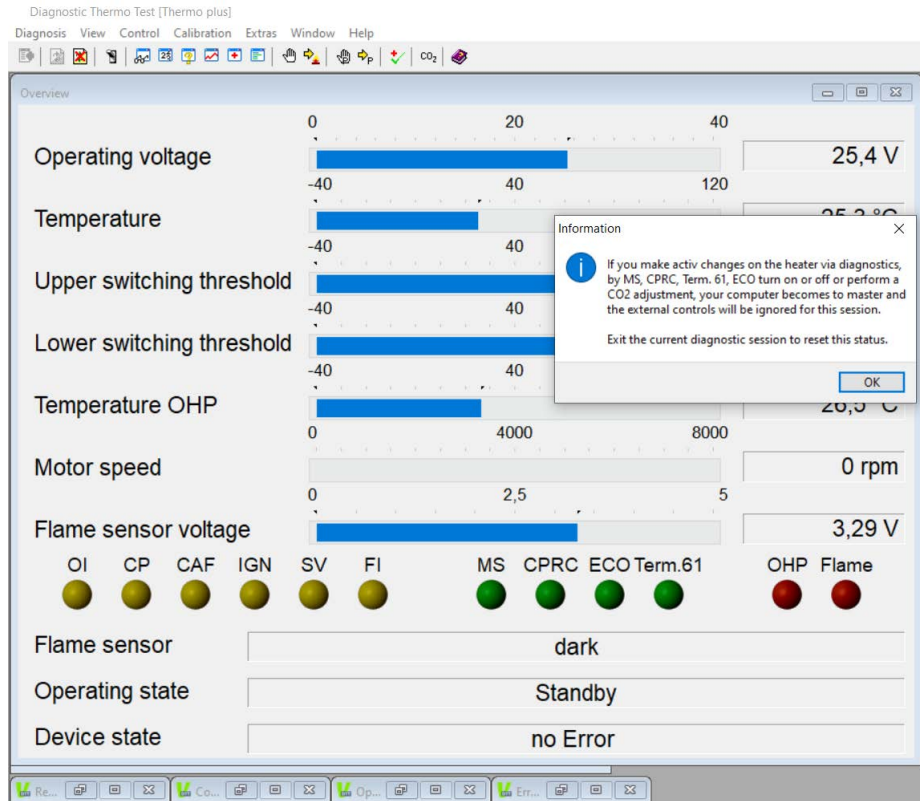
### Step 1:

Load diagnostic software



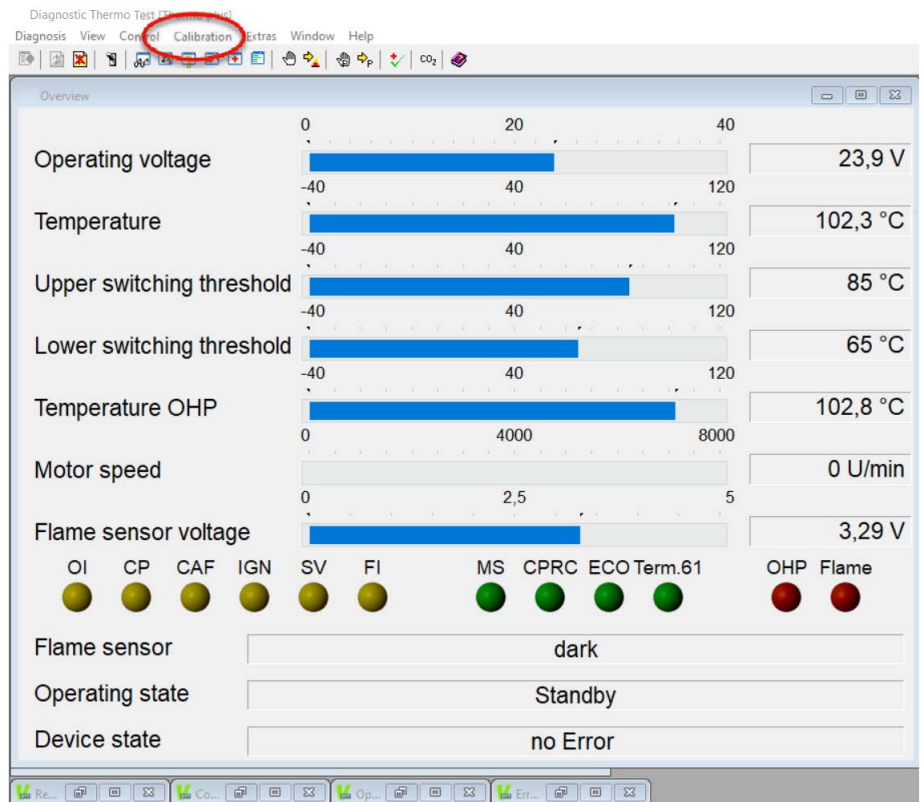
## Step 2:

Start diagnosis  
 (select the heater automatically  
 or manually)



## Step 3:


Start calibration  
 (CO<sub>2</sub> setting)



## WARNING:

Circulation pump active and coolant flow necessary.


Warning ×

 Please ensure that the circulation pump is triggered and there is enough coolant available to obtain the required rate of flow.

## NOTE

Required CO<sub>2</sub> measuring device

Warning ×

 For performing this function a CO<sub>2</sub> measurement device is required.


## ATTENTION

A flue gas extraction system must not be installed directly on the exhaust gas pipe of the heater. It must be installed at a sufficient distance to prevent influencing the CO<sub>2</sub> reading.

### Step 4

Start the CO<sub>2</sub> setting and heater start-up.

Confirm ×

 Start heater for CO<sub>2</sub> adjustment now?

### Step 5

The heater now starts and then switches to stabilized heating mode.

Wait for CO<sub>2</sub> adjustment ×

State

Wait for heater start!

Ignition

Wait for CO<sub>2</sub> adjustment ×

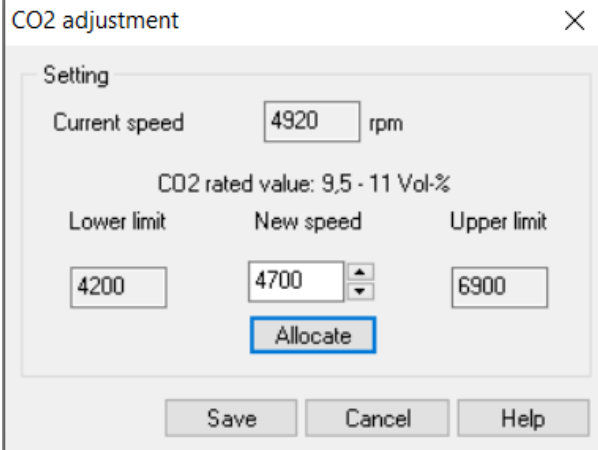
State

Wait for CO<sub>2</sub> stabilisation!

Engine independent heating

## Step 6

After some time, the exhaust gas values have stabilized.  
The fan speed can be adjusted.



CO2 adjustment

Setting

Current speed 4920 rpm

CO2 rated value: 9,5 - 11 Vol-%

Lower limit 4200 New speed 4700 Upper limit 6900

Allocate

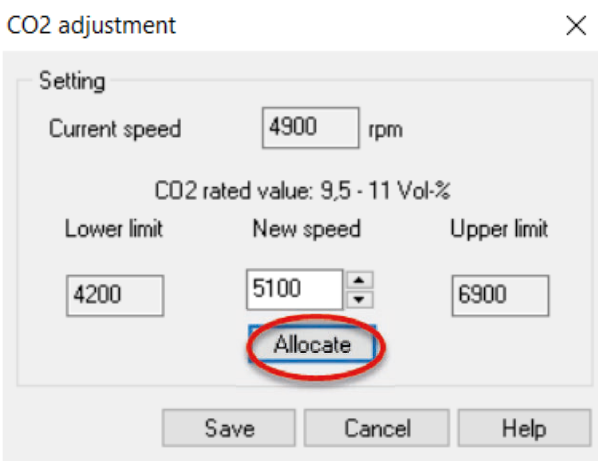
Save Cancel Help

## NOTE

An increase in speed causes a reduction in the CO<sub>2</sub> value and the other way round.

## Step 7

If the speed has been changed, the 'Assign' button is used to initially set the speed to change the CO<sub>2</sub> value



CO2 adjustment

Setting

Current speed 4900 rpm

CO2 rated value: 9,5 - 11 Vol-%

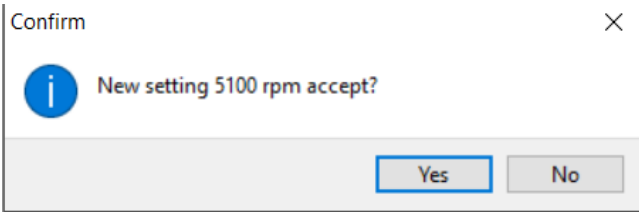
Lower limit 4200 New speed 5100 Upper limit 6900

Allocate

Save Cancel Help

## Step 8

If the new speed is to be **permanently** adopted and **saved** in the control unit, this must be confirmed.



Confirm

New setting 5100 rpm accept?

Yes No

## Step 9

The CO<sub>2</sub> setting is now finalized, the heater stops heating operation and switches to run-on mode.

The diagnosis can now be ended and the connection to the heater removed.