

**ecom<sup>®</sup>-J**

**Instruction manual**



rbr Computertechnik GmbH  
Am Großen Teich 2  
D-58640 Iserlohn (Sümmern)

Phone : (0 23 71) 945-5  
Fax : (0 23 71) 4 03 05



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## 1.0 Introduction

Dear user,

the composition of flue gases can be quickly and easily determined using the ECOM-J. The ECOM-J's many and varied capabilities and user friendly operation guarantee savings in time and money.

The following pages explain how to use the ECOM-J flue gas analysis computer and how to use its varied capabilities most effectively.

We wish you every success in using our ECOM-J flue gas analysis computer.

Yours faithfully rbr-Computertechnik GmbH

## 2.0 Important information

The instrument uses electrochemical sensors. The reactions in these sensors are pressure and temperature dependent. A system of pump and pressure regulators ensures that the sensors receive sufficient gas. Over pressure should be avoided when sampling. The storage temperature should be between 0 and 45°C and the operating temperature between 5 and 35°C. within these ranges a concentration measurement corresponds to the legal requirements.

Electrochemical sensors can be damaged if exposed to condensation. Therefore the state of the water trap should be checked regularly during a measurement and it should be emptied after a measurement so as to avoid the instrument sucking in condensation. Similarly condensation in the sampling system effects the accuracy of the draught measurement (pressure fluctuation caused by liquid moving in the tubing).

Please take particular care during cold weather to ensure that the instrument is at room temperature as otherwise condensation can form inside the instrument causing problems. Damage due to condensation is not covered by the guarantee.

After emptying the water trap the instrument should be purged with air for approx. 3 minutes. The CO and O<sub>2</sub> concentrations should be observed during this period. The instrument has been sufficiently purged when the O<sub>2</sub> concentration is more than 20.7% and the CO concentration is less than 5 ppm.

### 3.0 Measured and calculated values

The ECOM-J is a portable analysis computer for monitoring flue gases and for calculating the efficiency of burners. The instrument can measure :

- |                              |                                |
|------------------------------|--------------------------------|
| - Room temperature           | T - Room in °C                 |
| - Flue gas temperature       | T - Gas in °C                  |
| - Oxygen content in flue gas | O <sub>2</sub> in %            |
| - Carbon monoxide content    | CO in ppm (mg/m <sup>3</sup> ) |
| - Chimney draught            | Draught in hPa                 |

In addition the ECOM-J is able to carry out soot number measurements. The following are calculated using the values listed above :

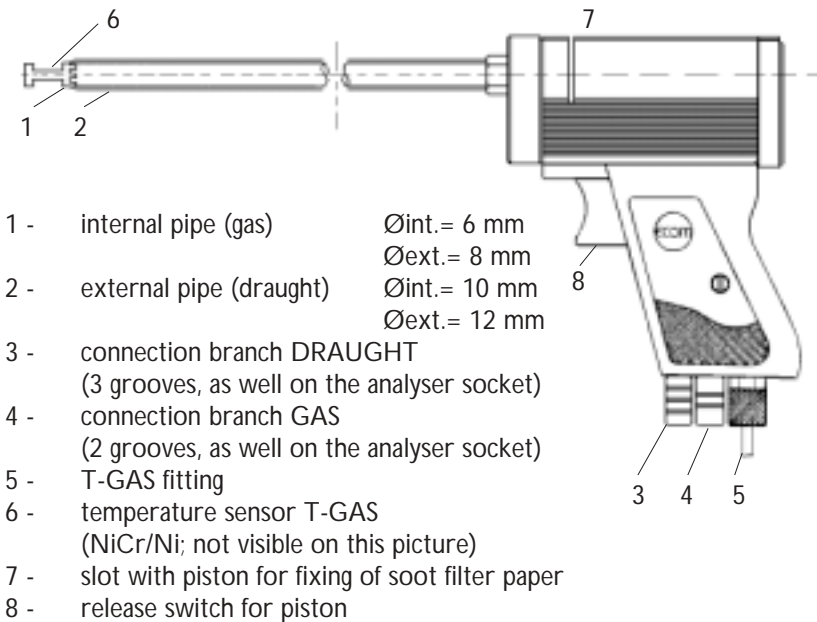
- |                           |                      |
|---------------------------|----------------------|
| - CO <sub>2</sub> content | CO <sub>2</sub> in % |
| - burner efficiency       | ETA in %             |
| - losses                  | losses in %          |
| - air excess number       | lambda               |

Furthermore in a special mode the instrument specifications can be displayed :

- O<sub>2</sub> sensor absolute voltage
- CO sensor offset voltage
- Pressure sensor offset voltage
- Battery voltage
- CO<sub>2</sub> max. according to selected fuel type
- factors A and B (used by BlmSchV to calculate losses)
- Telephone number of the nearest service centre

## 4.0 Sampling

The ECOM-J comes complete with heated flue gas sampling tubing and cone shaped positioning flange. This enables the position of the sampling probe to be adjusted in the gas channel

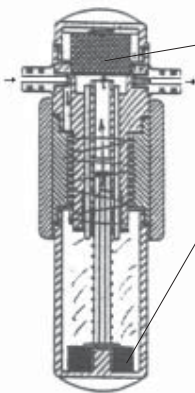


for inlets of between 11 and 16 mm. The thermo element at the tip of the probe measures the flue gas temperature.

Characteristic values for comparison can only be measured at a clearly defined point within the gas stream. The usual method is to find the main stream. Loosen the screw securing the positioning cone and move the probe in the flue gas channel whilst observing the gas temperature. The thermo element and the measurement point are in the main stream when the flue gas temperature is at a maximum. After securing the probe, gas measurement, soot measurement and draught measurement can be carried out in any order. The energetic measurement should however be made first.

Please note air can only be drawn into the instrument during the calibration phase.

### Condensation trap



Fine dust filter

Condensation trap with pad

The water catchpot is only operable when pulled upward. The electrical connection to the analyser must be performed, otherwise an error message will be displayed "Position water catchpot !".

The condensate forming is caught by the pad which stretches upward against the spring pressure and switches two contacts while achieving the maximum capacity: the gas sucking pump switches off. The analyser is herewith best protected against condensation. A performing fine dust filter cleans the sampled gas before entering the analyser.

Both components (fine dust filter and condensation pad) are to be changed if need be, while simply screwing off the corresponding cap, removing the soiled parts and installing new ones.



## 5.0 Measurement

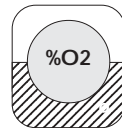
The gas probe must be placed in the flue during the measurement. The room temperature sensor should be placed near the opening in the flue. The instrument can now measure the following components simultaneously :

- room temperature
- gas temperature
- oxygen content in the flue gas
- carbon monoxide content

The following parameters are calculated :

- theoretical CO<sub>2</sub> content
- CO concentration relative to 0% oxygen
- burner efficiency (ETA)
- air excess ( $\lambda$ )

The display (printing and saving) of the CO data in mg or ppm can be selected using the key "%O2" as described below (6.3).



## 6.0 Measurement

### 6.1 BImSchV

After switching on the following message appears on the display:

On pressing the key "E" the program starts the calibration phase. The instrument checks itself for any faults. Possible error messages include :

**Flue measurement ? <E>**

- set-up water trap
- connect T-room sensor
- connect T-gas sensor

The pump remains switched off as long as the error message remains on the display. Only after correcting the error does the pump start up again and the calibration phase continues. The display contrast can be adjusted during calibration using the arrow keys.

On completing the three minute calibration the following appears on the display :

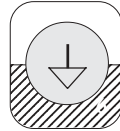
**Boiler temp. > °C**

Using the number keys (0-9) the preliminary temperature can be entered as the boiler temperature (0-999 °C). -°C flashes to show that the numerical keys are active. The boiler temperature does not have to be entered every time it is chiefly used in the measurement report and as a reference point for repeated measurements.

Pressing "E" skips the input and the display now reads :

<b>Fuel type :</b> <b>Heating oil</b>
--

Use the arrow keys to select the required fuel type.



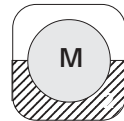
Pressing "E" confirms the selection and starts the measurement :

<b>O2</b>	<b>21,0 %</b>
<b>CO</b>	<b>0 ppm</b>

Using the arrow keys all mea-

sured and calculated parameters can be displayed. The upper arrow key changes the display in the upper line of the display, the lower arrow key changes the lower line. The same channel cannot be displayed twice.

Once the values displayed have stabilised the whole measurement can be stored in a temporary memory by pressing "M". A small "m" appears on the display in the lower right hand corner. Pressing "M" again clears the memory.



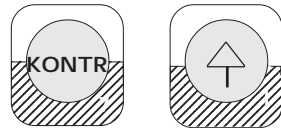
Storing the data in the memory is necessary if a printout is required. Only the values found in the memory can be printed.

**Note :** All ECOM instruments have as standard an option for checking the sensors. This applies both to their status (current values) and their function. The CO sensor can be manually removed from the gas line (see section Control program) and is automatically checked by the instrument. If the CO concentration exceeds 4000 ppm a valve closes off the gas inlet to the sensor and a pump purges the sensor with air. The sensor is automatically reconnected when the concentration drops below 1500 ppm.

This reliably prevents the sensor from being exposed to excessive concentrations and protects its ability to measure accurately, particularly in the lower ppm range.

## 6.2 CO measurement

The CO measurement can be accessed from the energetic measurement by pressing the control key and then the up arrow key. The display now reads :



By pressing "START" the instrument enters measurement mode. CO measurement is then accessed by pressing "E" causing 4 parameters to be displayed.

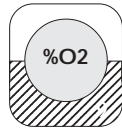
**BlmSchV measurement  
change: <START>**

- CO
- CO      0 % O2
- O2
- lambda

The results can be stored by pressing "M" and be printed later. The values stored from a CO measurement do not affect values stored during a BlmSchV, draught or soot measurement.

## 6.3 Selection of reference value

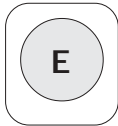
If the instrument is in normal mode the CO value output can be altered without interrupting the measurement. After pressing “%O2” the display reads:



< ppm>	mg
0%- ppm	0% mg

The required display format

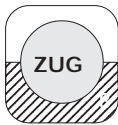
can be selected by pressing “START”. The excess oxygen value can be entered using the numbers 0-9. Pressing “E” exits this mode and returns to the measurement display.



When displaying the CO value relative to x percent excess oxygen, dashes are displayed with oxygen values greater than 20.0 %.

## 6.4 Draught measurement

Pressing “Draught” accesses the chimney draught measurement mode. The display reads :



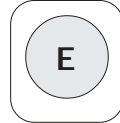
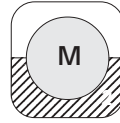
<b>Press &lt;START&gt; then connect tube !</b>
--



The pump switches off. Pressing “START” sets the draught sensor to 0.00 hPa (ambient pressure). Connect the tube to the inlet marked “Draught” and the display now shows the draught reading.

Once the display has stabilised, the value can be stored by pressing "M". Pressing "E" again switches the pump back on and returns to the normal measurement mode.

**Draught :**  
**0,00 hPA**



**Please note that for all other measurements the tube must be connected to the inlet marked "Gas" !**

## 6.5 Soot measurement

Pressing "SOOT" switches the pump off and the display reads :



**Soot measurement :**  
**attach soot filter**



Pressing "START" switches the pump back on and draws in exactly 1.63 l of flue gas through the soot filter. During this time the volume is displayed eg. :

**1st. soot measurement**  
**volume 1,16 l**

As soon as the required volume has been drawn in, the pump switches off and the display reads :

**1st. soot measurement**  
**soot number : 0**

The soot number obtained



from the comparison scale can now be entered using the numerical keys. Pressing "START" starts the next soot measurement (procedure as above).

After finishing all three soot measurements and pressing "START" the display shows :



oil derivate : no



"START" switches between "yes" and "no".

The soot number is automatically stored.

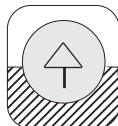


Pressing "E" returns to the normal mode.

The soot measurement can be interrupted by pressing "E" when asked for the soot number. The instrument then returns to the normal measurement mode.

## 7.0 Soot probe heating

A heated gas probe is standardly delivered for performing soot measurements. The heating of the probe is powered directly from the in built transformer and only functions when the instrument is connected to the mains, it does not function with the batteries. When the heating is switched on (automatically when the unit is switched on), the red light above the ON/OFF switch lights up. The heating can be switched on and off by pressing "START" when in control mode. First press "CONTR" and then the up arrow until the display reads :



Probe heating ?  
<Start> : yes

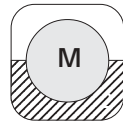


Pressing start switches the heating on or off. Press "E" to return to the measurement mode.

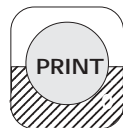
If the instrument is connected to the mains, the heating will come on after switching the instrument on.

## 8.0 Printer and remote control

The printer can only print out data which has been stored by pressing "M". The printout contains all the information stored in the memory plus the oxygen reference concentration, the date and time, type of measurement, instrument type and two lines of text (eg. company name and telephone number). If there are data from a CO measurement and a BlmSchV measurement in the memory, two reports will be printed. Results from a draught measurement are printed out in the BlmSchV report, if they have been stored, the soot measurement is stored automatically.



Pressing "PRINT" activates the printer. The display changes and displays the contents of the memory (print buffer) during the printout. Once the printout is completed the display returns to normal. Printing out the data does not erase the data from the memory. To do this press either "M" (the "m" in the display disappears) or switch the instrument off.



The optional remote control unit ECOM-Z can display all of the data shown in the display during a normal measurement (the remote control ECOM-Z mini only displays T-gas, O<sub>2</sub> and CO). If the instrument is not in normal mode (eg. soot or draught



measurement) then the remote control for the printer is deactivated. If the printer is switched on using the remote control then the actual values being measured are printed out.

## 9.0 CO measurement for solid fuel

Key "INTEG".



The ECOM-J can measure CO concentrations up to 10000 ppm which can occur when burning solid fuels (wood) for example. This section can be called up by pressing "INTEG" after connecting up the filter unit ECOM-G-PLUS (see ECOM-G-PLUS instructions for details) or another filter system to clean and dry the gas being measured. The display then asks for the G-PLUS (or other filter system) to be connected and then to press "START". The following then appears on the display:

O <sub>2</sub>	— %
CO (wood)	ppm

As with the other measurements the normalisation value for oxygen can be adjusted by pressing "%O<sub>2</sub>". The printout from this measurement, headed CO measurement, only contains results for O<sub>2</sub>, CO and lambda.

This section can only be exited by switching the instrument off.

**Important, please note** : In "INTEG" mode the automatic overload cut out is deactivated, therefore the CO sensor must be purged until it reads below 30 ppm, before the instrument is switched off.

## 10.0 Control program

Pressing "CONTR" in normal mode activates the control program. Various messages appear on the display and the relevant section can be set using the arrow keys. Pressing "E" returns to the normal



mode.

### Control program



1.

CO - off ? <Start> : no
----------------------------

Pressing "START" disconnects or reconnects the CO sensor.

### Control program 2.



Choose between the complete BlmSchV measurement or a flue gas measurement (CO measurement).

**BlmSchV measurement  
change : <Start>**

### Control program 3.



Pressing "START" switches the probe heating on and off.

**Probe heating ?  
<Start> : yes**

### Control program 4.



In this mode the paper is advanced one line (eg. when changing the paper).

**Paper feed ?  
<Start> :**

### Control program 5.



This section sets the date and time. To set the clock proceed as follows: press "START", the day flashes. Using the numerical keys enter the new date and confirm with "E". The month now flashes and can be altered. Continue as above for the time as well.



The last "E" exits the procedure.

Date	Time
04.01.89	12:10:40

## Control program 6.

This program is used to check the battery voltage. The voltage can only be displayed when the instrument is using the batteries.

<b>Battery voltage :</b> <b>11.57 V</b>
--

If the instrument is connected to the mains, the following is displayed.

<b>Battery on charge !</b>
----------------------------

## Control program 7.



The boiler temperature can be corrected or entered. Press "START" to activate the number keys and enter the value required. "E" completes the entry and stores the value.



<b>Boiler temp.-&gt; -°C</b>
------------------------------

## Control program 8.



Pressing "START" in this mode enables the fuel type to be selected using the two arrow keys. The choice of fuel type is then confirmed by pressing "E".



**Fuel type :**  
**heating oil**

## Control program 9.

These parameters are the factors used to calculate the CO<sub>2</sub> content, the losses and the efficiency dependent on fuel type (see Appendix III of 1<sup>st</sup> BImSchV).

**A1 = 0,50 A2 = 0,68**  
**B = 0,007 CO2 = 15,4**

## Control program 10.

This menu gives the offset values for the individual sensors.

**O2 2162mV CO 0mV**  
**Dra. 12mV**

The oxygen sensor functions

similarly to a metal-air battery. Its consumption curve is determined by the length of exposure and gas concentration (O<sub>2</sub>) which can lead to loss in capacity. A new sensor has a voltage of more than 2100 mV. This value drops with time and should not fall below

approx. 600 mV. The offsets for the toxic gas sensor (CO) are the zero point compensation values. These voltages should be between  $0 \pm 15$  mV. If they are greater than this, then the calibration should be repeated or the sensor should be recalibrated. The offset value for the draught sensor is entered after the calibration phase. Due to the sensors sensitivity, this value drifts after a short time and so the sensor should generally be calibrated immediately before a draught measurement, as is explained in section 6.4.

## **Control program 11.**

The value given by the operating time counter is in hours and minutes. The time is increased in whole minutes.

<b>Operating time : 10.23 hours</b>
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## Control program 12.

The telephone number of the nearest service centre.

<b>Service :</b> <b>02371/44029</b>
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## Control program 13.

The production date or date of the last service and the instrument serial number.

<b>rbr 08:02:90</b> <b>Ser.No. : 12345</b>
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## 11.0 Measurement principles

### 11.1 Gas temperature measurement

The temperature of the flue gas is measured using a Ni-/CrNi with a range of 0 to 600°C. Short term temperatures up to 800°C can also be measured. The signal is linearised in the instrument giving an accuracy of  $\pm 2^\circ\text{C}$ .

### 11.2 Room temperature measurement

The room temperature is measured by a separate sensor with a three meter long cable. The sensor is enclosed in a small metal capsule which is equipped with a magnet for attaching the sensor

to the burner.

The sensor can measure in the range 0 to 99°C. The actual sensor is a PTC semi-conductor.

### **11.3 Soot measurement**

The pump is electronically controlled and draws the required 1.63 litres in approx. 60 seconds. The program enables 3 consecutive pump cycles in each case followed by the input of the oil derivate.

### **11.4 Oxygen measurement**

An electrochemical sensor (fuel cell) is used to measure oxygen. After completion of the calibration phase (in fresh air), the O<sub>2</sub> sensor voltage is measured and stored by the instrument. This voltage is then set at 21.0% O<sub>2</sub> for all following measurements. The sensor operating life is approx. 1.5 - 2 years. The minimum voltage is checked by the internal test program and a relevant error message displayed.

### **11.5 Carbon monoxide measurement**

An electrochemical sensor with no hydrogen cross sensitivity (4 electrode sensor) is used for the carbon monoxide measurement. The sensor is also temperature compensated. The sensor compensation (cross sensitivity and temperature)



can only be carried out in our workshops as a special climatic chamber and specific software are needed. The CO calibration however can be carried out at any test point.

The NO sensor also operates using the same measurement principles but has a permanent bias of 200 mV to hinder drift.

### **Baseline compensation (calibration phase)**

After completion of the calibration phase, the sensor baselines are stored. The values are then used to correct values measured later.

The sensors are linear and have been calibrated at the top end of their measurement range. Temperature and cross sensitivity effects are compensated for in the software.

## **12.0 Power supply**

The following power supply options for the ECOM-J enable the instrument to be used in many areas and give the user the largest amount of freedom when measuring in situ.

### **12.1 Battery**

The ECOM-J comes equipped as standard with two 6V/1.2 Ah rechargeable batteries and with protection against the charge becoming too low. The batteries will last for approx. 3 hours. The heated probe however cannot be used (only possible with mains power supply).

When the battery voltage drops to about 10.8 V, the red LED begins to flash and at 10.5 V the instrument switches itself off.

The batteries are automatically recharged by connecting the instrument to the mains. This is irrespective of whether the instrument is on or off. Overcharging is not possible. Recharging completely empty batteries takes approx. 14 hours.

### **12.2 Mains power supply**

For long measurements and in the lab. the ECOM-J should be connected to a 220 V mains supply. This also applies to short term measurements as this prolongs the life of the batteries.

## 13.0 Technical information

Range :

oxygen O <sub>2</sub>	0 - 20.9 vol.%
carbon monoxide CO (for solid fuels	0 - 4000 ppm 0 - 10000 ppm)
carbon dioxide CO <sub>2</sub>	depends on fuel
flue gas temperature	0 - 500°C
room temperature	0 - 99°C
burner efficiency (Eta)	0 - 99.9% (calculated)
flue losses	0 - 99.9% (calculated)
air excess	1 - x
chimney draught / pressure	± 19.99 hPa
soot number	Bacharach scale (0-9)

Display :

two part 20 character LCD

Calibration :

automatic after switch on (reference - air)

Parameters :

all instrument values can be accessed via the keyboard.

Power supply :

mains supply 220 V / 50 Hz  
in built batteries 2 x 6 V / 1.2 Ah

**Sensors :**

O <sub>2</sub> /CO	electrochemical
gas temperature	Ni -/CrNi thermo element
room temperature	separate sensor in metal capsule
chimney draught	DMS bridge

**Operating temperature :**

15 - 45 °C

**Measurement temperature :**

max. 500 °C

**Gas probe :**

length 250 mm

**Tubing :**

combi-tubing, 3m

**Extras :**

soot filter, removable water trap, gas probe, soot probe.

## 14.0 Maintenance and servicing

The flue gas analysis instrument, ECOM-J, should be checked over regularly to ensure that the accuracy and life of the sensors is maintained. We recommend that you send the instrument to one of our service stations or back to us after approx. one year, so that the programming and sensors can be checked and any worn parts replaced.

Daily maintenance is limited to one or two checks carried out before and after a measurement.

### A) before a measurement

1. Is the SO<sub>2</sub>/NO<sub>x</sub> filter on the front still ok. ?

The filter granules remove sulphur dioxide and nitrogen oxides from the CO sensor line as they would otherwise falsify the measurement. When new, the filter is pink and brown in colour, this changes to dark brown/black and then to grey/white. Once the granules turn grey, the filter must be replaced.

2. Is the particle filter colour less than 3 - 4 using the soot number scale ?

This filter must be replaced regularly as the filter material also absorbs water vapour from the water trap, which can effect the NO measurement in instruments with an NO sensor. We recommend changing the filter every day and allowing the old filter to dry out. As long as the filter colour is less than 3 - 4 on the soot number scale, it can be used further.

3. Is the water trap empty and secured ?

Pull the water trap mounting up as high as possible before starting the calibration, otherwise the calibration may not be able to start.

4. Have the batteries enough voltage ? (see Control program 10)

5. Have the sensors been correctly calibrated and have no

baseline drift ? (see Control program 10)

6. Are the date and time correct ? (see Control program 5)

## **B) after a measurement**

1. Has the CO-sensor been purged with air to below 10 ppm ?

2. Empty and dry the water trap.

3. Empty condensation out of the sample system tubing, blow through and leave to dry.

Check for creases in the tubing and check the seals on the sampling system from time to time.

4. Clean the probe regularly (compressed air).

5. Recharge the batteries. Connect the instrument to the mains without switching on. Over charging is not possible.

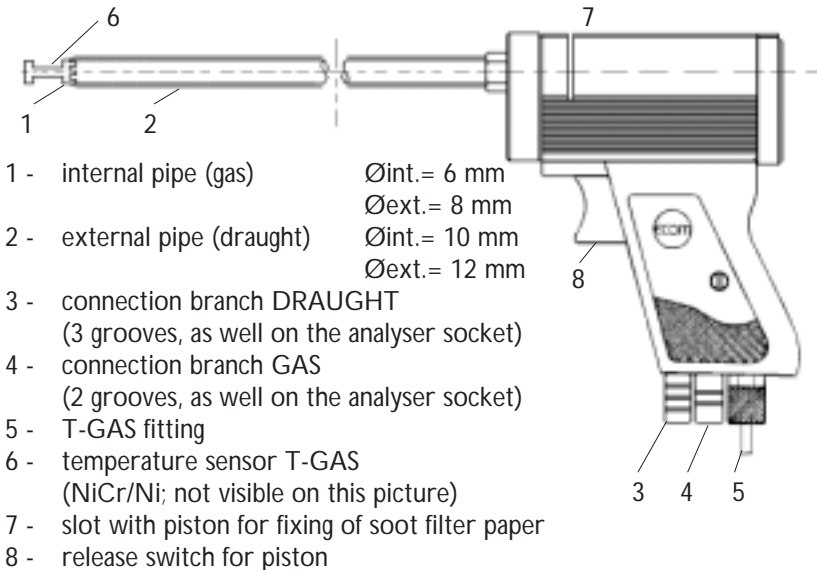
6. Lightly grease the connection from time to time with acid free grease (eg. pump oil).

## Changing the printer paper

The standard printer in the ECOM-J is a thermal printer with 58 mm wide paper. To change the paper roll, simply open the printer and insert the new roll making sure that the end of the paper is underneath and towards the printer rollers. Cut the end of the paper to a point and push through the rollers. Pull gently until the paper is fully in the printer. Take care not to cause any loops when closing the printer.

## Pistol grip probe

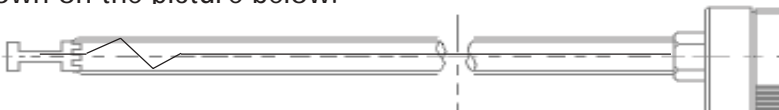
The standard delivery of the ECOM-J covers a heated coaxial probe. This probe is dismantlable and consists of the following parts:



For cleaning purposes, the probe can be dismantled as follows:

1. screw off the external pipe (DRAUGHT) from the grip part and pull it off.
2. the internal pipe (GAS) can then also be pulled off. Take care for the O-ring being present, thus securing the tightness of the system.

By re-building the thermoelement tip should never touch the probe pipe. Hereto the thermo wire should be slightly bent as shown on the picture below:



*(Technical specifications herein may be modified without notice) August 1993*

notes:

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