Manual

Carbon and Sulfur Analyzer CS-800

Translation

ELTRA
ELEMENTAL ANALYSERS

Table of Contents

1 Contact information

Please contact your local representative in the event of problems. You can find the complete list of dealers at www.eltra.com.

Of course you can also contact ELTRA-Germany directly:

ELTRA GmbH
Retsch Allee 1-5
42781 Haan
Germany
Web: www.eltra.com
Email: service@eltra.com

2 Notes on the Manual

This Operating Manual provides technical instructions for the safe operation of the device and contains all necessary information about the topics given in the table of contents. This technical documentation is meant to be a tutorial and a reference. The individual chapters are self-contained.
Knowledge of the relevant chapters (for the respective target groups defined according to areas) is a prerequisite for the safe and correct use of the device.
This Operating Manual contains no repair instructions. In the event of any faults or necessary repair work, please contact your supplier or Eltra GmbH directly.

Amendments

Subject to technical changes.

2.1 Explanations of the Safety Instructions

In this Operating Manual we give you the following safety warnings

Mortal injury may result from not following these safety warnings. We give you the following warnings and corresponding content.

DANGER

Type of danger / personal injury
Source of danger
– Possible consequences if the dangers are not observed.
• **Instructions on how the dangers are to be avoided.**

We also use the following signal word box in the text or in the instructions on action to be taken:
DANGER

Serious injury may result from not following these safety warnings. We give you the following warnings and corresponding content.

WARNING

Type of danger / personal injury
Source of danger
– Possible consequences if the dangers are not observed.
• **Instructions on how the dangers are to be avoided.**

We also use the following signal word box in the text or in the instructions on action to be taken:
WARNING

Moderate or mild injury may result from not following these safety warnings. We give you the following warnings and corresponding content.

CAUTION

Type of danger / personal injury
Source of danger
– Possible consequences if the dangers are not observed.
• **Instructions on how the dangers are to be avoided.**

We also use the following signal word box in the text or in the instructions on action to be taken:
CAUTION

In the event of possible **property damage** we inform you with the word “Instructions” and the corresponding content.

NOTICE

Nature of the property damage
Source of property damage
– Possible consequences if the instructions are not observed.
• **Instructions on how the dangers are to be avoided.**

We also use the following signal word in the text or in the instructions on action to be taken:
NOTICE

2.2 General Safety Instructions

C1.0002

CAUTION

Read the manual

Non-observance of the operating instructions

- The non-observance of this manual can result in personal injuries.
- **Read the manual before using the device.**
- **The adjacent symbol indicates the necessity of knowing the contents of this manual.**

Target group:

All activities required for correct use are described in this Operating Manual. Any activities that go beyond this may only be performed by authorised electricians who have received in-depth training for this analyzer.

As the operating company, you must ensure that the following applies to the persons working on the analyzer;

- Operating personnel have been made aware of and have understood all safety regulations;
- Operating personnel are familiar when starting work with all handling instructions and regulations that apply to the relevant target group for them;
- Operating personnel have access at all times to the technical documentation of this analyzer;
- New personnel are familiarised with the safe and intended use of the analyzer before starting work on it by means of a verbal introduction by a competent person and using this technical documentation.

Incorrect operation can result in injury and damage to property. You are responsible for your own safety and for that of your employees.

Ensure that no unauthorised persons have access to the analyzer.

C2.0089

CAUTION

Changes to the machine

- Changes to the machine may lead to personal injury.
- **Do not make any change to the analyzer and use spare parts and accessories that have been approved by Eltra exclusively.**

N1.0074

NOTICE

Changes to the machine

Improper modifications

- The conformity declared by EltraEltra GmbH with the European Directives will lose its validity.
- Any warranty claims will be terminated.
- **Do not make any modification to the machine.**
- **Use spare parts and accessories that have been approved by EltraEltra GmbH exclusively.**

2.3 Explanation of signs and symbols

Number	Symbol	Reference	Meaning
12			Danger, high voltage, electric shock
13		IEC 60417-5041	Caution, hot surface
14		ISO 7000-0434B	General hazards – see documentation
-		BGV A8 W27	Risk of crushing

3 Packaging, Transport and Installation

3.1 Packaging

The packaging has been adapted to the mode of transport. It complies with the generally applicable packaging guidelines.

3.2 Transport

N2.0075

NOTICE

Transport

- Mechanical or electronic components may be damaged.
- **The device must not be bumped, shaken or thrown during transport.**
- **The device must be transported upright**

3.3 Intended use

This analyzer was designed for the analysis of mainly steel and other metals. However, a wide variety of materials such as cement, ceramics and soil can also be analyzed.

With restrictions concerning sample weight and accuracy, also coal, rubber, plastics etc. can be analyzed.

Depending on the application, the sample weights, accelerator(s) and settings on the analyzer can significantly influence the accuracy and precision of the measured values.

Use is only permitted in the laboratory by appropriately trained and briefed personnel.
All other applications are prohibited, in particular use in non-industrial areas.

3.4 Conditions for the Installation Site

Requirements regarding the operating conditions:

- For indoor use only.
- Operation up to max. 2,000 m above sea level.
- Ambient temperature of between 5°C and 40°C.
- Maximum relative air humidity < 80 % (at ambient temperatures ≤ 31°C), with linear decrease up to 50% relative air humidity at 40˚C, non-condensing.
- A residual current operated device (RCD), and a corresponding fuse (30 mA).

⚠ **WARNING** Provide an external fuse when connecting the mains lead to the mains in accordance with the regulations at the installation site.

- Information about the required voltage and frequency of the device can be found on the type plate .
- The data listed must be consistent with the existing power supply system.
- The device may only be connected to the power supply system using the connecting lead supplied.

N3.0022

NOTICE

Electrical connection

Failure to heed the data on the type plate

- Electronic and mechanical components may be damaged.
- **Only connect the device to a power supply system that is consistent with the data on the type plate.**

– Fluctuations of the mains supply voltage up to ± 10 %.
– The device must be operated in accordance with overvoltage category II and pollution category 2, DIN EN 61010-1.
– Industrial environment in accordance with DIN EN 61010-1

3.5 Type Plate Description

N4.0022

NOTICE

Electrical connection
Failure to observe the values on the type plate

– Electronic and mechanical components may be damaged.
- **Connect the device only to mains supply matching the values on the type plate.**

Fig. 1: Type plate

1	Device designation
2	Serial number
3	Year of manufacture
4	Voltage definition
5	Amps
6	Power
7	Manufacturer's address
8	Item number
9	Mains frequency
10	Protection type
11	Disposal label
12	CE mark

Please quote the device designation (1), the serial number (2) of the device and the item number (7) if you have any queries.

4 Installation

4.1 Setting check up

CAUTION V0092

Device falling down
Incorrect erection or inadequate working space

- Due to its weight, the device can cause injuries if it falls down.
- **Only operate the device on a sufficiently large, strong, non-slip and stable working area.**
- **Ensure that all feet of the device are standing securely.**

WARNING W1.0021

Fire hazard / Risk of burns
Hot parts (crucibles, reagents,...) can fall down

- Ignition of tables, floors, or any other surface the hot part falls on
- Ignition of clothes and any other material
- **Set up the analyser in a flame retardant environment. Pay special attention to the table, the floor and any other surface being in the near of the analyzer**
- **Always wear suitable clothing**
- **Keep the work environment clear of all materials that could catch fire**

NOTICE

Installation of the machine

- It must be possible to disconnet the machine from the mains at any time.
- **Install the machine such that the connection for the mains cable is easily accessible.**

Since the analyzer weighs about 85 kg it should be placed on a suitably stable surface. The balance should also be placed on a surface which is free of vibrations. The balance can be placed in any location, although positioning the balance to the right of the analyzer is proven to be best suitable. The balance can of course also be placed on a weighing table next to the analyzer. There are no special requirements for setting up the printer and computer; they can be placed on a normal desk.

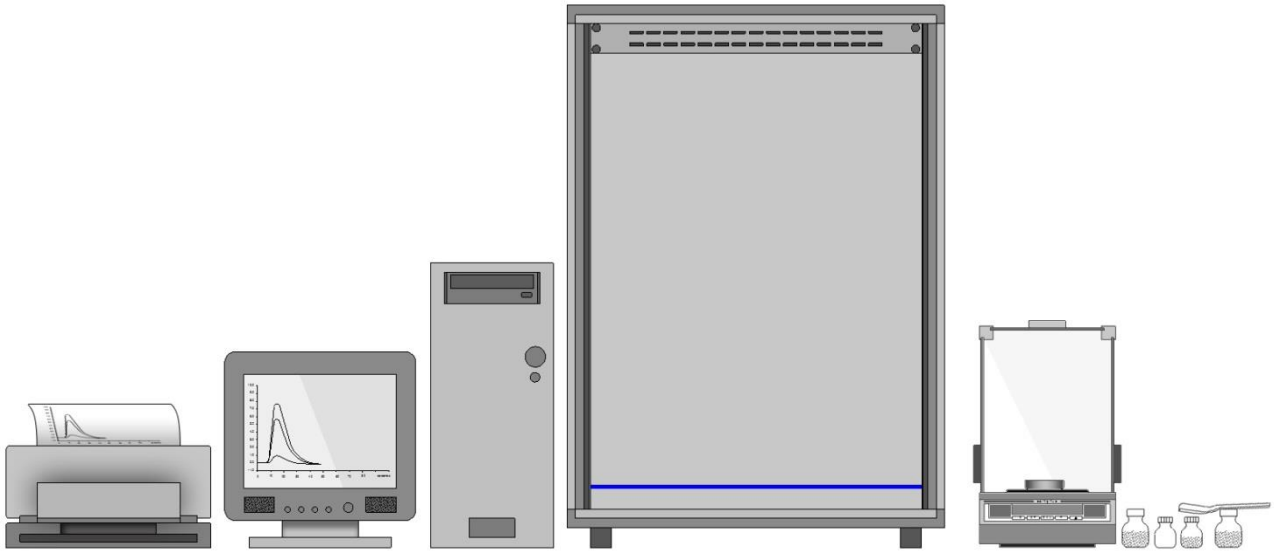


Fig. 2: Example of installation

Although the analyzer's operating environment does not necessarily need to be air conditioned, it is advisable to keep the room temperature between 18°C and 30°C.
Under no conditions should the device be exposed to direct sunshine!
Avoid places exposed to the wind of air conditioners or to the wind blowing through open windows or doors.

4.2 Front panel illustration

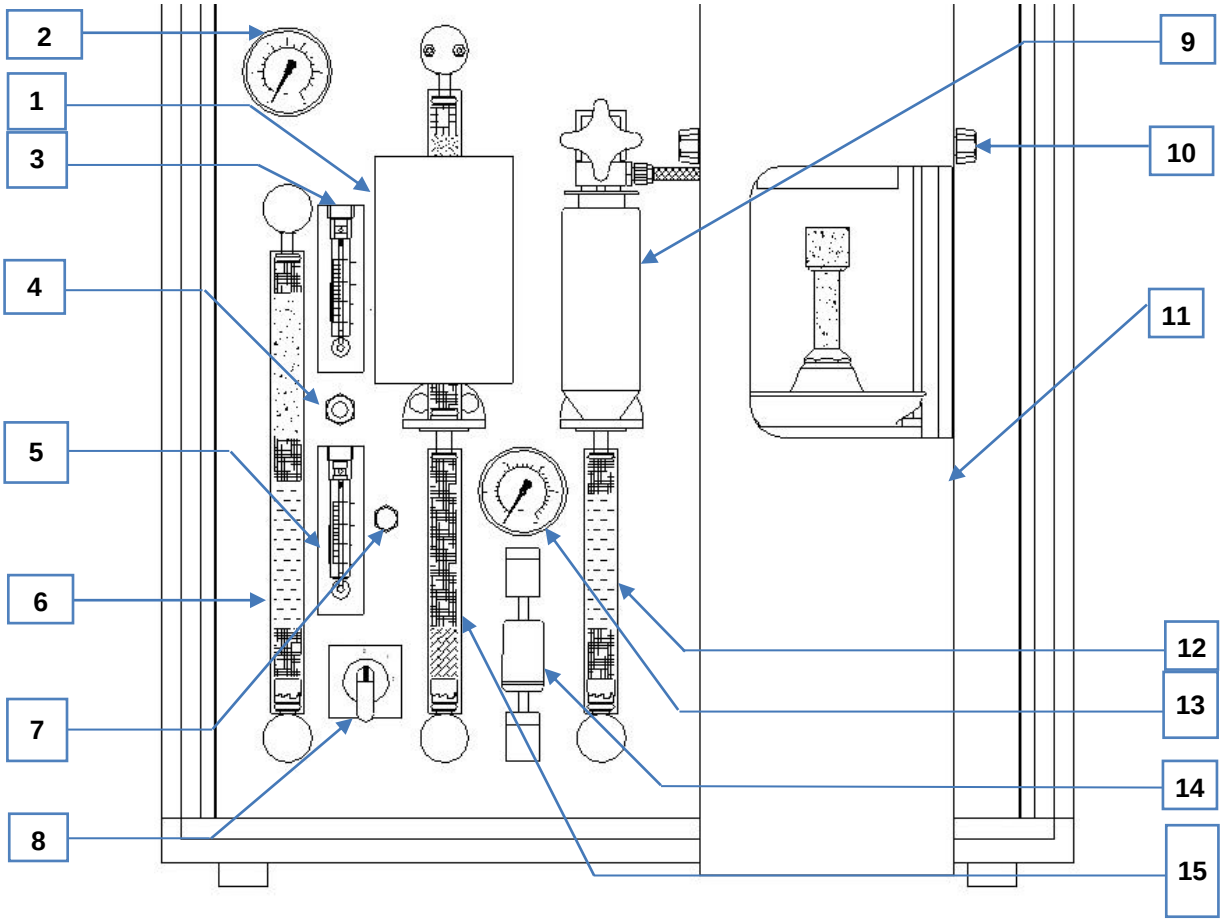


Fig. 3: Front view

1	Catalyst furnace
2	Oxygen pressure gauge (norm. 1,5 bar)
3	Infrared cell purge 10 l/h
4	Regulator for infrared cell purge (3)
5	Carrier gas flow
6	CO_2 / H_2O – trap
7	Button for leakage test
8	Mains power switch
9	Dust filter
10	Cover attachment knobs
11	Furnace cover
12	H_2O – trap
13	Compressed air gauge (norm. 5 bar)
14	Dust filter cartridge
15	SO_3 - trap

4.3 Mains power connections

Since the infrared cell requires about 1 hour to reach a stable operation temperature, it is advisable to connect the analyzer to the mains power first immediately switch it on before further installation work is carried out.
This waiting time is only necessary when switching on the analyzer from cold condition. It is then normally not switched completely off, in order to always be at constant operation temperature. During long work breaks, the analyzer is on stand-by, which is on position 1 of the mains power switch.

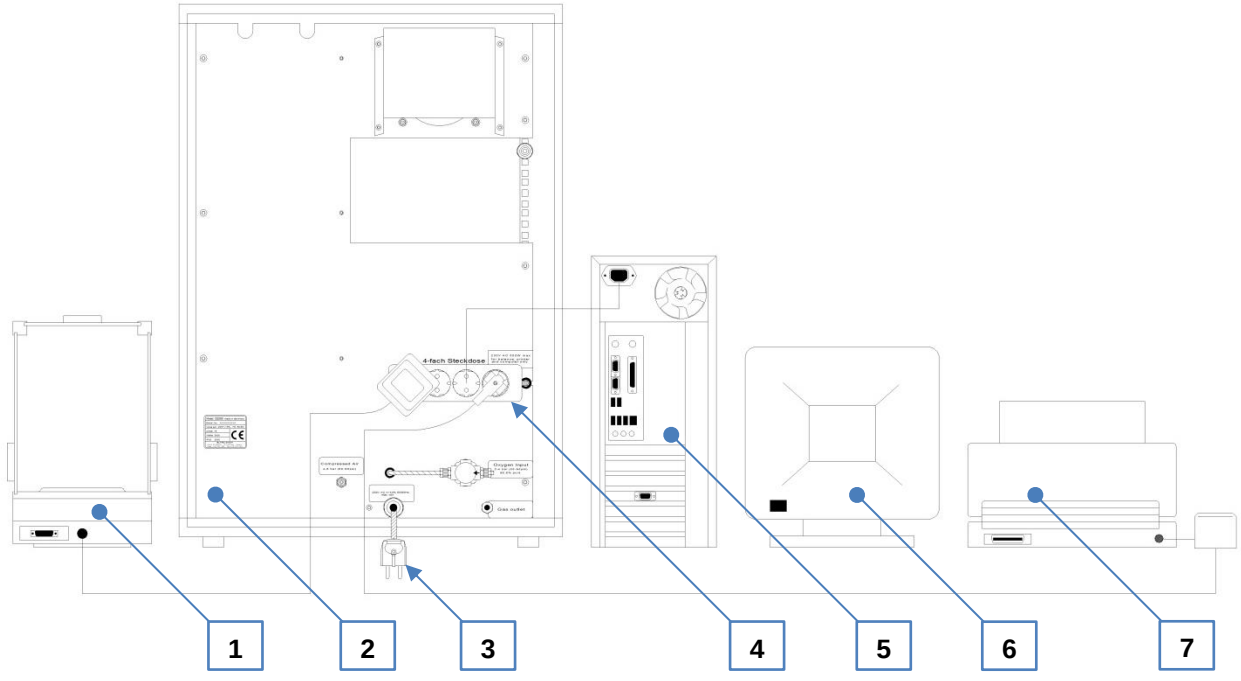


Fig. 4: Mains power connection - rear view

1	Balance
2	Analyzer
3	Analyzer mains plug
4	Quad power socket
5	Computer
6	Monitor
7	Printer

First connect the analyzer to the mains power and switch it on to position 1 in order to win time. The power switch is located on the front panel in the low left hand corner. Set to position 1. The reason why to first switch on the analyzer is for the infrared detectors to have time to stabilize their temperature while cable connections and software start are made.

4.4 Data Interface

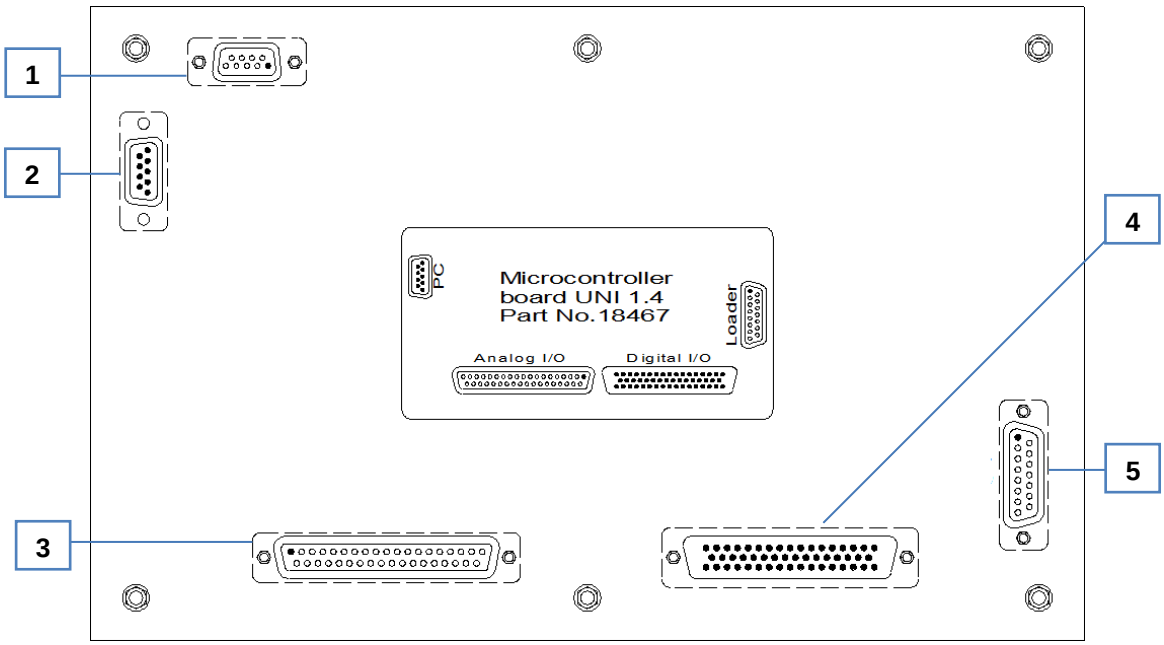


Fig. 5: Data interfaces

1	Spare serial interface
2	PC connection (serial interface (COM-port))
3	Analog input/output signals
4	Digital input/output signals
5	Autoloader connection

When all devices are connected to the mains power, then data connections can be made. The plugs are all different to each other, so that they cannot be interchanged. The required data cables are included in the boxes of additional peripheral devices supplied with the analyzer. These are adapted to the interfaces when the analyzers are put into operation in our company. The serial interface of the balance is programmed in order to match the required configuration for weight transfer to the PC.
The computer is already provided with an operating system and software for controlling the analyzer.

NOTICE

For information about using the PC for operating the analyzer, refer to the UNI-software help manual.

4.5 Gas connections

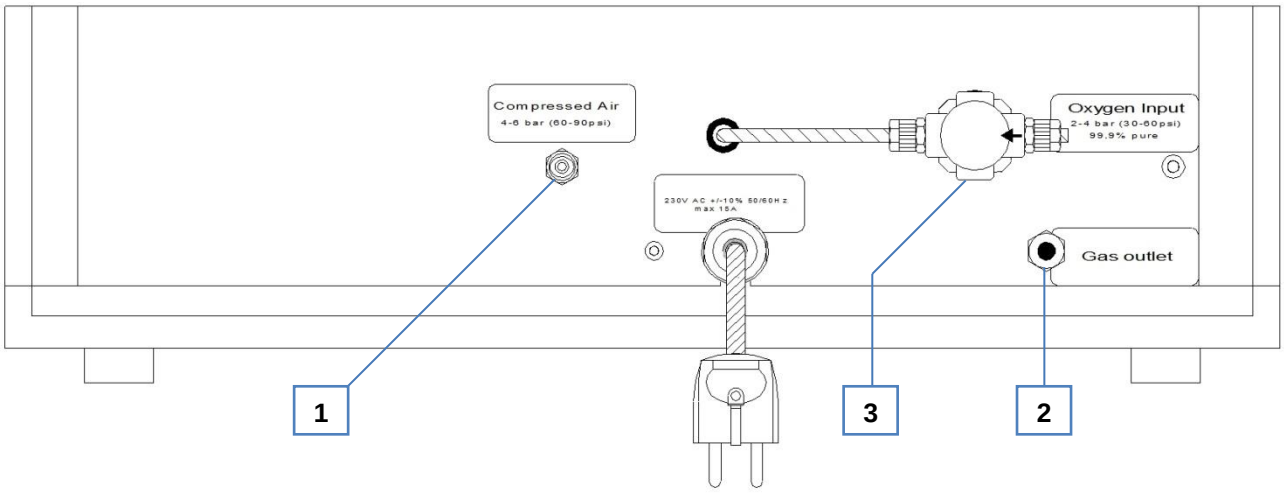


Fig. 6: Gas connections

1	Compressed air (4-6 bar, 60-90psi)
2	Gas outlet
3	Oxygen inlet (2-4 bar, 30-60psi)

Two gas connections are necessary to operate the analyzer. The required tubes are included in the delivery. See above diagram.

Tube (3) for the oxygen supply is 5m long with 6mm outer diameter having a fitting with G1/4" inner thread to be connected to the oxygen supply.

Tube (1) for the compressed air is 5m long with 4mm outer diameter having a fitting with G1/4" inner thread to be connected to the compressed air supply.

Tube fitting (3) connects the analyzer with an oxygen bottle via a pressure regulator. This connection must be very secure, since the operating pressure in the tube is between 2 and 4 bar (30 to 60psi). Gas connection (1) is for the compressed air supply to the pneumatic cylinder (piston) and the internal cooling for the induction coil.

Gas connection (2) is for connecting the analyzer's exhaust to ventilation. It is mostly not used, due to low quantities of CO_2 and even lower quantities of SO_2 resulting from the sample combustion.

When the analyzer's mains switch is set to position 2, a valve opens and the oxygen can flow through the gas flow system. The flow rate is stabilized within a few seconds to 180 l/h and is monitored on the lower flow meter.

4.6 Gas purification furnance connecting (optional)

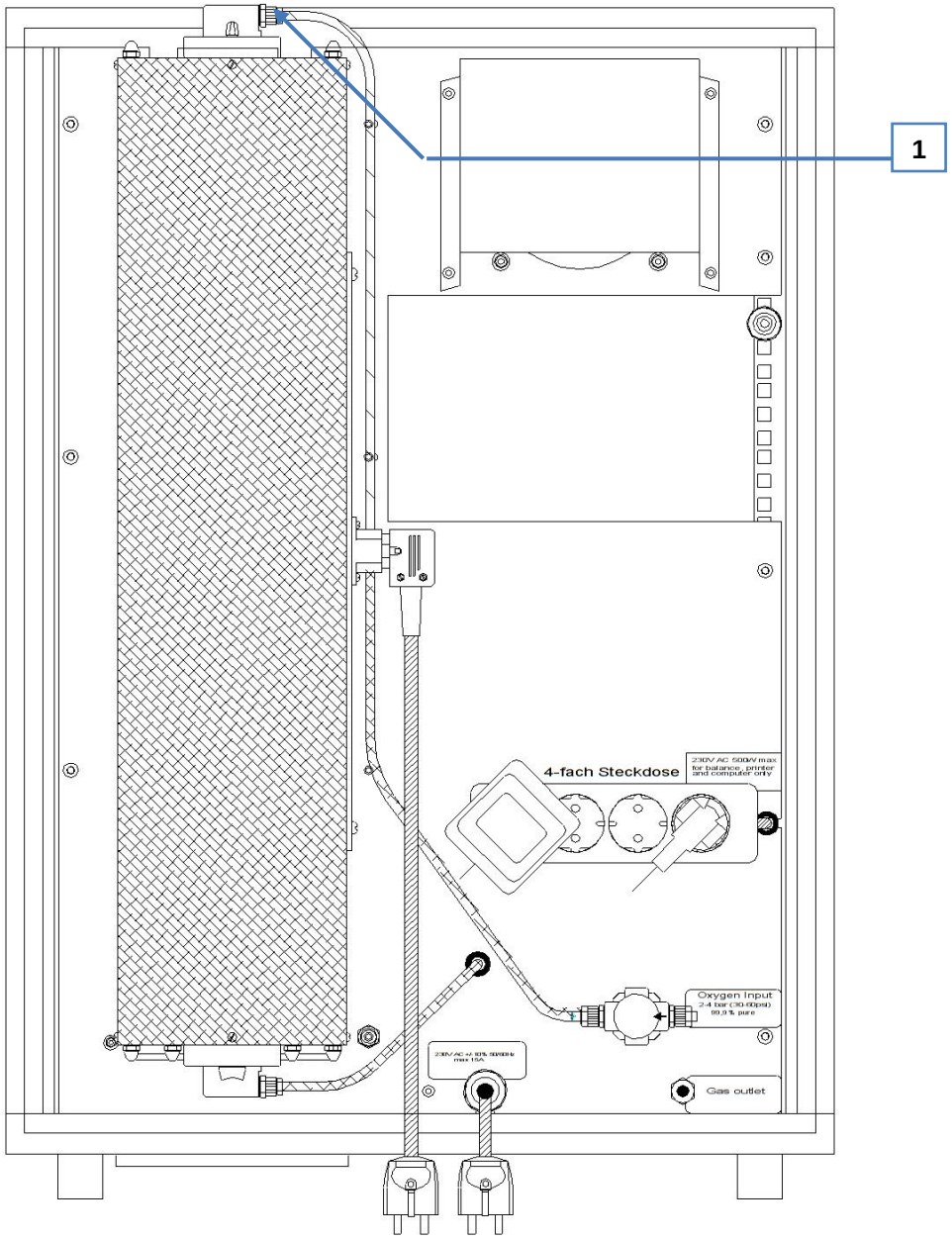


Fig. 7: Connecting the gas purification furnace

The tube from the pressure regulator is connected to the lower fitting of the gas purification furnace (optional), and the tube (1) is connected on its place. See above diagram.

4.7 Autoloader (optional)

Fig. 8: Auto loader

The CS-800 can be supplied with an automatic sample loading system. This loading system may also be retrofitted at a later date. Unlike many other auto loaders the ELTRA system can accommodate up to 130 samples enabling hours of unattended operation. On request, the loader can be delivered for more or less crucibles. The auto loader, which does not occupy any additional bench space, is mounted above the area where the balance, PC, monitor and consumables are normally placed. The crucibles positions on the loader are easily accessible to the operator even from sitting position. The operation of the CS-800 with an auto loader requires a PC for easy manipulation of sample weight storage and out of sequence samples. For instructions on installing and operating the auto loader read the Loader manual which is delivered with the loader.

5 Analysis

5.1 Working procedure

D1.0006

DANGER

Danger caused by scalding by samples
Sample material

- Damage to the respiratory tracts, skin and/or mucous membranes.
- Radiation damage.
- **The user must himself assess the risk emanating from a sample during the analysis.**

W2.0021

WARNING

Fire hazard / Risk of burns
Hot parts (crucibles, reagents,...) can fall down

- Ignition of tables, floors, or any other surface the hot part falls on
- Ignition of clothes and any other material
- **Set up the analyser in a flame retardant environment. Pay special attention to the table, the floor and any other surface being in the near of the analyzer**
- **Always wear suitable clothing**
- **Keep the work environment clear of all materials that could catch fire**

C3.0093

CAUTION

Hot crucibles

- A hot crucible can cause injuries or damage to property on contact or if it falls down.
- **Adapt the "Post waiting time" so that the crucible can cool down sufficiently.**
- **Take care that no flammable materials are situated below the furnace opening**

The CS-800 was designed for the analysis of mainly steel and other metals. However, a wide variety of materials such as cement, ceramics and soil can also be analyzed. With restrictions concerning sample weight and accuracy, also coal, rubber, plastics etc. can be analyzed. The sample weight, the accelerator(s) and the sensitivity of the analyzer are different, depending on the respective sample material properties during combustion.

NOTICE

For optimum CS analysis of coal, rubber, plastics and generally organic samples, we offer CS analyzers employing resistance furnaces. We also offer the CS-2000 which is an analyzer having both, induction and resistance furnace for optimum analysis of both, organic and inorganic samples.

The analysis of steel is described in the following section, as an analysis example.

Ensure that the compressed air and oxygen supplies are turned on. They should normally not be turned off, at least during working hours when only short breaks between analyses take place. By turning the mains power switch to position 2 the heating for the generator tube filament and the cooling blower are switched on, as well as a valve which allows the oxygen to enter the gas flow system. It is advisable to let the oxygen flow through the analyzer for several minutes before beginning of analysis, so that air is purged out of the IR cells and their

temperature is stabilized. During brief work breaks, therefore, the oxygen is not turned off and the mains power switch is left on position 2.
Make sure that the chemicals are in proper condition and that they are of the right quality. See chapter Chemicals (Maintenance)
A crucible is placed on the balance and tarred by pressing the tare key or F6 on the key board of the PC.

NOTICE

Never touch the crucibles with fingers. Take them with clean tongs only.
1.5g tungsten is then weighed in the crucible. Tare the balance again. The sample is weighed as next. Usual sample weight is about 500mg for steel or cast iron samples. Transfer the weight from the balance by clicking the "F4-Balance" button or simply F4 on the keyboard of the PC. The sample weight appears in the "Weight-mg" field. (The transfer function is performed regardless of how often the button is pressed. This enables a correction of any previously entered wrong weight.)

NOTICE

Transfer to the PC the sample weight only. Never transfer the accelerator weight.
The crucible is placed on the pedestal and the analysis is started.
The "F5-START" button starts the analysis based on the weight which is shown on the screen when it is pressed. (This weight is used for calculation of the result for the running sample.) The furnace then closes, the word ANALYSIS appears in the status window of the PC screen, indicating that the analysis cycle is running. The analysis now runs by itself, so that nothing more needs to be done manually. The signals from the infrared cells are monitored on the graphics window of the software. At the end of analysis the results are shown on the screen.
If an IR cell may be saturated, it is switched off, by software. If a low range has been built in and it is overloaded, the analyzer changes automatically over to the high range. If high ranges are overloaded, a row of asterisk will appear on the display. When the next analysis is started, overloaded cells are automatically reactivated.

NOTICE

Never change the mains power switch from position 1 to 2 while ANALYSIS appears in the status window. If, however, the analysis is mistakenly started while the mains switch is in position 1, the analysis should be interrupted with the abort button. The sample weight must be re-entered before restarting analysis.

NOTICE

Before pressing abort note the sample weight, because it must be reentered manually before restarting. The first analysis after switching to position 2 should be carried out after a couple of minutes, because the oxygen supply and the blower are thereby switched on causing temperature drift of the infrared cell.

5.2 Analysis example

The analysis of steel and cast iron is generally carried out with approx. 500mg of sample (normally grains or pieces) by adding 1,5 tungsten accelerator.

5.2.1 Combustion peak

The combustion is quite rapid and the peaks on the PC screen look as follows:

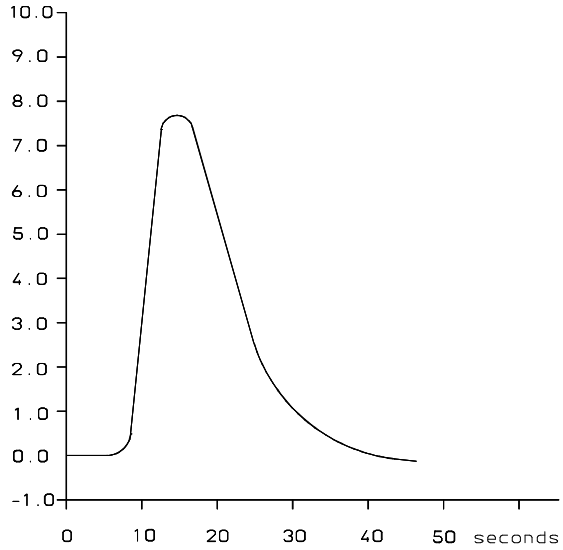


Fig. 9: Combustion peak

5.2.2 Combustion double peak

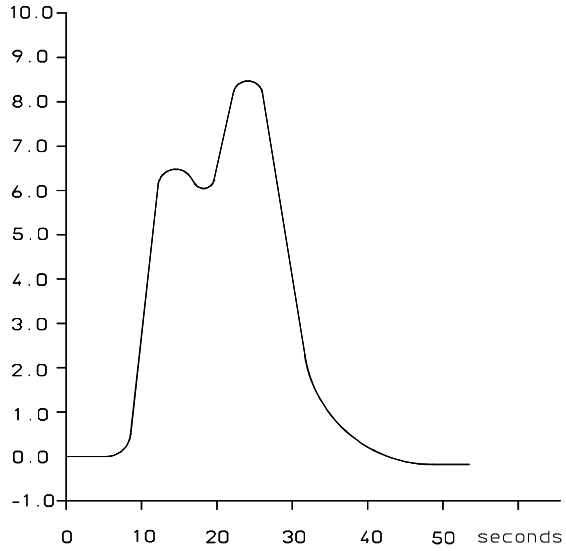


Fig. 10: Combustion double peak

The reason is that either the sample doesn't contain enough iron or the sample is made of metal powder.

In this case take 2g tungsten instead of 1.5g. If the combustion still provides double peaks or there is yellow dust on the inner surface of the crucible after the analysis, take 1g tungsten, 500mg pure Iron accelerator and 500mg sample.

In case of metal analysis the dust trap has to be cleaned and the moisture trap has to be replaced every 100 analyses or at least every two days. See chapter General Information (Maintenance)

The combustion tube doesn't need any cleaning by the operator, due to automatic cleaning after each analysis.

5.3 Work breaks

Work breaks, e.g. during lunch breaks, the mains switch remains on position 2. During longer interruptions, e.g. after finishing work for the day, the mains switch is set to position 1 (standby). The analyzer's thermostatic control is then working and no long warm-up time is needed, when re-starting the analyzer. The energy consumption and wear are negligible on standby.
The mains switch is set to pos.2 for about 10-15 minutes before starting the first analysis. Air and any moisture which has entered the analyzer are purged by the oxygen flow. The minor influence which the oxygen flow has on the temperature of the infrared cell is compensated by the thermostatic control. The analyzer is designed for long term use, so that no damage results.
The furnace should always be kept closed during work breaks, so that no moisture from the environmental air can enter the furnace area. Moisture on the inner furnace surface an mainly in the dust filter will bound SO_2 so that the first analyses after long break with open furnace will give low sulfur results for the first few analyses, especially when the sample contains very low sulfur. Moisture from the dust filter can also disturb the base line of the sulfur range.
The furnace should be opened only while replacing crucibles. All the rest of the time it should remain closed.
The furnace remains open only when the analyzer is completely switched off. When the mains switch is on zero, for safety reasons the crucible lift is down.

5.4 Crucibles preheating, optional

C4.0096

Caution

Eye injury
Hot combustion tube.

- Eye damage.
- **Avoid looking directly into the hot combustion tube. For eye protection use the supplied protective glass.**

C5.0076

CAUTION

Scalding/burns
Hot furnace / combustion tube / analyzer parts

- Parts of the analyzer can be very hot.
- **Use heat protecting gloves.**

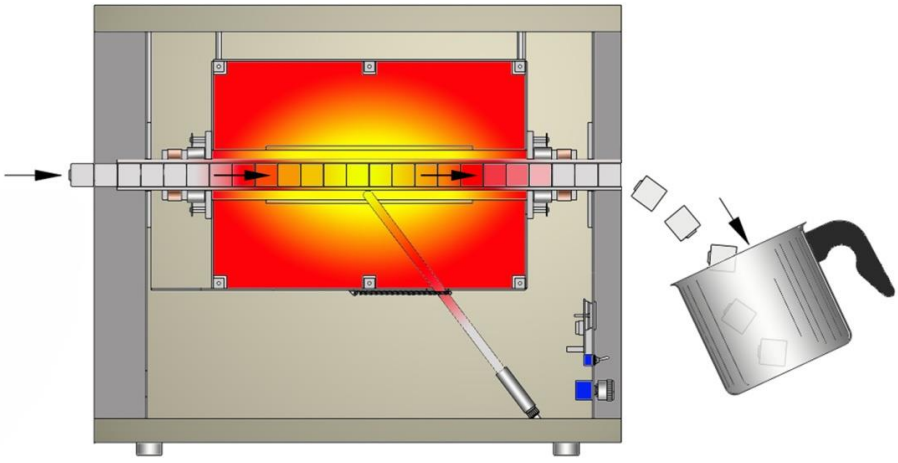


Fig. 11: Crucibles preheating

The above furnace is used for preheating crucibles. It is an optional accessory and can be purchased separately.
When analyzing samples with low concentration of carbon or sulfur (<1000 ppm), the pre-heating of the crucibles is advisable.
The crucibles contain traces of carbon, which can vary from 20 to several hundred ppm, depending on their quality. Additionally, this blank value is not constant; it can be different for different crucibles. These problems, of course affect the accuracy of the analyses, therefore by pre-heating the crucibles, their carbon impurities will be largely eliminated. The remaining blank value therefore, will be very low and it will remain fairly identical for each crucible. This is important for keeping results deviations low.

5.4.1 Operating the pre-heating furnace (optional)

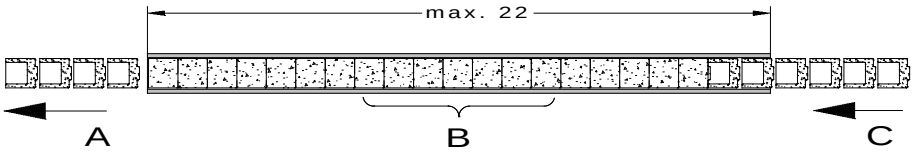


Fig. 12: Operating the pre-heating furnace

NOTICE

Do not move more than 4 crucibles at a time into the furnace. Otherwise the combustion tube may break, due to temperature shock caused by incoming cold crucibles.
Set temperature: 1000°C
After five minutes feed-in the next four crucibles if needed(C).
Up to 22 crucibles fit inside the furnace. (B) is the hot zone inside the furnace.
When entering new crucibles into the furnace for preheating, an equal number of preheated crucibles will fall off the other end (A) of the furnace tube.

5.5 Applications

LC – low carbon measuring range
HC – high carbon measuring range
LS – low sulphur measuring range
HS – high sulphur measuring range

Material/ Analysis time (s)	Sample + Accelerators	Calibration		Typical results
Aluminium 50s	1.5g ± 0.2g Tungsten 700mg ± 50mg Sample 0.7g ± 0.1g Nickel	**LC**	0.1% C Steel	60ppm C
		HC	2.0% C Steel	3% C
		LS	0.1% S Steel	0.2% S
		HS		
Ash 50s	1.6g ± 0.2g Tungsten 120mg ± 50mg Sample 0.5g ± 0.1g Iron	**LC**	0.1% C Steel	
		HC	2.5% C Steel	3.5% C
		LS	0.1% S Steel	
		HS		
$BaCO_3$ 50s	1.7g ± 0.2g Tungsten 110mg ± 30mg Sample 0.8g ± 0.2g Iron	**LC**		
		HC	6.08% C $BaCO_3$	6.08% C
		LS		
		HS		
$BaSO_4$ 50s	1.0g ± 0.2g Tungsten 200mg ± 100mg Sample 1.0g ± 0.2g Iron	**LC**		
		HC		
		LS		

Material/ Analysis time (s)	Sample + Accelerators	Calibration		Typical results
		HS	13.7 %S $BaSO_4$	13.7% S
Lead pieces 100s Comparator level =1	2.5g ± 0.2g Tungsten 2.0g ± 0.1g Sample	**LC**	0.1% Steel	60ppm C
		HC		
		LS	0.1% S Steel	100ppm S
		HS		
Lead powder 100s Comparator level =1	2.5g ± 0.2g Tungsten 800mg ± 100g Sample	**LC**	0.1% Steel	60ppm C
		HC		
		LS	0.1% S Steel	100ppm S
		HS		
Soil 60s	1.8g ± 0.2g Tungsten 250mg ± 50mg Sample 0.7g ± 0.1g Iron	**LC**	0.048% C Steel	0.03% C
		HC	1.03% C Steel	3.0% C
		LS	0.13% S Cast iron	1.0% S
		HS	0.336% S Steel	2.0% S
$CaCO_3$ 50s	1.7g ± 0.2g Tungsten 110mg ± 30mg Sample 0.8g ± 0.2g Iron	**LC**		
		HC	12% C $CaCO_3$	12% C
		LS		
		HS		
CaO 60s	1.7g ± 0.1g Tungsten 370mg ± 20mg Sample 0.8g ± 0.1g Iron	**LC**	0.048% C Steel	
		HC	1.33% C Steel	0.192% C
		LS	0.13% S Cast iron	0.017% S
		HS	0.336% S Steel	
Cast iron 50s	1.2g ± 0.2g Tungsten 400mg ± 100mg Sample 0.3g ± 0.1g Iron	**LC**		
		HC	1.33% C Steel	0.192% C
		LS	3.0% S Cast iron	0.017% S
		HS	0.1% S Cast iron	
Ceramics 60s	2.2g ± 0.2g Tungsten 150mg ± 50mg Sample 0.7g ± 0.1g Iron	**LC**		
		HC	12% C $CaCO_3$	5.98% C
		LS	0.103% S	
		HS	0.336% S Cast iron	2.57% S
Cement 60s	0.8g ± 0.1g Tungsten 200mg ± 50mg Sample 0.8g ± 0.1g iron	**LC**		
		HC	12% C $CaCO_3$	
		LS		
		HS	13.7% S $BaSO_4$	
Cement 60s	200mg ± 50mg Sample 1.1g ± 0.1g Iron	**LC**	1% C Cement	
		HC	2% C Cement	
		LS	1% S Cement	
		HS		
Chrome 70s	1.5g ± 0.2g Tungsten 200mg ± 50mg Sample 0.8g ± 0.1g Iron	**LC**	0.048% C Steel	0.003% C
		HC	1.33% C Cast iron	
		LS	0.13% S Cast iron	0.001 %
		HS		
Chrome oxide 50s	1.5 ± 0.2g Tungsten 220mg ± 50mg Sample 0.6g ± 0.1g Iron	**LC**	0.1% C Steel	0.02% C
		HC		
		LS	0.1% S	0.025% S
		HS		
Limestone	1.8 ± 0.1g Tungsten	**LC**	0.048% C Steel	

Material/ Analysis time (s)	Sample + Accelerators	Calibration		Typical results
60s	250mg ± 50mg Sample 0.8g ± 0.1g Iron	**HC**	1.3% C Steel	1.5% C
		LS	0.13% S	0.11% S
		HS		
Cobalt 50s	1.8 ± 0.2g Tungsten 350mg ± 50mg Sample 0.3g ± 0.1g Iron	**LC**	0.048% C Steel	
		HC	1.3% C Steel	1.5% C
		LS	0.13% S	0.11% S
		HS		
Coal and coke 50s	1.5 ± 0.2g Tungsten 50mg ± 10mg Sample 0.5g ± 0.1g Iron	**LC**		
		HC	3.0% C Cast ironl	70% C
		LS	0.1% S Steel	5% S
		HS		
Copper swarfs Min. 60s Max. 90s Power: 4,5V Comp.level: 30mV	5g Sample	**LC**		
		HC		
		LS	15ppm S Copper	10ppm S
		HS		
Copper pin Min 60s Max. 90s Power: 4,5V Comp.level: 30mV	2.0g ± 0.2g Tungsten 1.0g - 2.0g Sample 0.1g ± 0.01g Iron	**LC**		
		HC		
		LS	0.1% S Steel	10ppm S
		HS		
Copper pieces Min. 60s Max. 90s Power: 4,5V Comp.level: 30mV	5g Sample (max. 1g/piece)	**LC**		
		HC		
		LS	0,1% S Steel	10ppm S
		HS		
Cu-Ni 50s	2.0g ± 0.2g Tungsten 0.7g ± 0.1g Sample	**LC**	0.048% C Steel	0.036% C
		HC	1.03% C Steel	
		LS	0.1% S Steel	40ppm S
		HS		
Nickel 50s	2.0g ± 0.2g Tungsten 0.8g ± 0.1g Sample 0.8g ± 0.1g Iron	**LC**	0.048% C Steel	
		HC	1.03% C Steel	
		LS	0.1% S Steel	17ppm S
		HS		
Fe-Cr 50s	2.5g ± 0.2g Tungsten 450mg ± 50mg Sample 0.2g ± 0.1g Iron	**LC**	0.1% C Steel	0.2% C
		HC	1.03% C Steel	6% C
		LS	0.1% S Steel	0.3% S
		HS		
Fe-Mn Fe-Mo 50s	1.5g ± 0.2g Tungsten 250mg ± 50mg Sample 0.4g ± 0.1g Iron	**LC**	0.1% C Steel	0.2% C
		HC	3.0% C Cast iron	6% C
		LS	0.1% S Steel	0.3% S
		HS		
Fe-Ni 50s	1.7g ± 0.2g Tungsten 700mg ± 100mg Sample	**LC**	0.1% C Steel	0.2% C
		HC	3.0% C Cast iron	6% C
		LS	0.1% S Steel	0.3% S
		HS		

Material/ Analysis time (s)	Sample + Accelerators	Calibration		Typical results
Fe-Si 50s	1.5g ± 0.2g Tungsten 250mg ± 50mg Sample 0.9g ± 0.1g Iron	**LC**	0.1% C Steel	0.2% C
		HC	3.0% C Cast iron	6.0% C
		LS	0.1% S Steel	0.3% S
		HS		
Fly ash 60s	2.2g ± 0.1g Tungsten 100mg ± 20mg Sample 0.3g ± 0.05g Iron	**LC**	0.048% C Steel	
		HC	6.08% C $BaCO_3$	10% C
		LS	0.13% S Cast iron	0.3% S
		HS		
Gypsum 60s	0.8g ± 0.1g Tungsten 200mg ± 50mg Sample 0.8g ± 0.1g Iron	**LC**		
		HC	12% C $CaCO_3$	
		LS		
		HS	13.7% S $BaSO_4$	18% S
Ores 60s	1.0g ± 0.2g Tungsten 130mg ± 30mg Sample 1.0g ± 0.2g Iron	**LC**		
		HC	12% C $CaCO_3$	10% C
		LS	0.1% S Steel	≈3% S
		HS	13.7% S $BaSO_4$	30% S
Iron ores 60s	2.0g ± 0.2g Tungsten 250mg ± 50mg Sample 0.5g ± 0.1g Iron	**LC**		
		HC	12% C $CaCO_3$	10% C
		LS	0.1% S Steel	≈3% S
		HS	13.7% S $BaSO_4$	30% S
Rock sample 60s	2.2g ± 0.2g Tungsten 150mg ± 50mg Sample 0.7g ± 0.1g Iron	**LC**		
		HC	12% C $CaCO_3$	5.98% C
		LS	0.103% S Steel	
		HS	0.336% S Steel	2.57% S
Rubber 60s	1.5g ± 0.2g Tungsten 40mg ± 10mg Sample 0.5g ± 0.1g Iron	**LC**		
		HC	3.0% C Cast iron	60% C
		LS	0.1% S Steel	1.9% S
		HS		
Silicon 60s	1.7g ± 0.2g Tungsten 80mg ± 20mg Sample 0.4g ± 0.1g Iron	**LC**		
		HC	12% C $CaCO_3$	
		LS	0.1% S Steel	0.02% S
		HS		
Silicon Carbide 70s	2.0g ± 0.2g Tungsten 60mg ± 10mg Sample 0.7g ± 0.1g Iron	**LC**		
		HC	12% C $CaCO_3$	30% C
		LS	0.1% S Steel	0.02% S
		HS		
Slag 60s	1.0g ± 0.2g Tungsten 500mg ± 100mg Sample 1.0g ± 0.2g Iron	**LC**	0.1% C Steel	
		HC	2.0% C Cast iron	
		LS	0.1% S Steel	0.8% S
		HS		
Steel 50s	1.5g ± 0.2g Tungsten 500mg ± 100mg Sample	**LC**	0.1% C Steel	0.1% C
		HC	3.0% C Cast iron	6% C
		LS	0.1% S Steel	0.3% S
		HS		
Titanium	1.4g ± 0.2g Tungsten	**LC**	0.1 %C Steel	0.016% C

Material/ Analysis time (s)	Sample + Accelerators	Calibration		Typical results
50s	500mg ± 100mg Sample 0.6g ± 0.1g Iron	**HC**		
		LS	0.1% S Steel	10ppm S
		HS		
Titanium oxide 60s	2.2g ± 0.2g Tungsten 300mg ± 50mg Sample 0.6g ± 0.1g Iron	**LC**	0.048% C Steel	
		HC		
		LS	0.013% S Cast iron	23ppm S
		HS		
Titanium oxide 60s	2.0g ± 0.2g Tungsten 220mg ± 20mg Sample	**LC**	0.048% C Steel	0.230% C
		HC		
		LS		
		HS		
Tungsten carbide 70s	1.7g ± 0.2g Tungsten 200mg ± 50mg Sample 0.6g ± 0.1g Iron	**LC**		
		HC	6.14% C WC	6.14% C
		LS		
		HS		
Uranium 50s	1.0g ± 0.1g Tungsten 800mg ± 100mg Sample 0.5g ± 0.1g Iron	**LC**	0.1% C Steel	0.50% C
		HC		
		LS	0.1% S Steel	0.07% S
		HS		

6 Maintenance

CAUTION

V0074

Scalding/burns
Hot furnace / combustion tube / analyzer parts

– Parts of the analyzer can be very hot.
- C**heck the furnace temperature in the software.**
- **For maintenance the furnace temperature has to be less than 40°C.**

6.1 General information

The maintenance example mentioned below is related to steel analyses and oxygen 99.5% pure.

6.1.1 Maintenance every 100 analyses:

Or at least once a month

- Replace the magnesium perchlorate after the metal filter. See chapter Reagent tubes filling
- Brush the metal filter. See chapter dust trap cleaning.

6.1.2 Maintenance every 500 analyses:

- Clean the metal filter in an ultrasonic cleaner. See chapter dust trap cleaning

6.1.3 Maintenance every 1000 analyses:

Or if 1/3 of the material turned grey

- Replace the paper filters.
- Replace the magnesium perchlorate of both glass tubes. See chapter Reagent tubes filling
- Replace the sodium hydroxide. See chapter Reagent tubes filling

6.1.4 Maintenance every 2000 analyses:

- Replace the copper oxide in the catalyst furnace. See chapter Reagent tubes filling
- Replace the furnace cleaning brush. See chapter furnace cleaning brush-replacing
- Replace the cotton wool. It should be replaced earlier when the upper half becomes dark. See chapter Reagent tubes filling

NOTICE
The above is related to steel analyses and oxygen 99.5% pure.
NOTICE
There are qualities of chemicals such as Anhydrone, ascarite, copper oxide, tungsten granules, iron chips, copper chips etc. which have been specially developed for analyzing instruments. The commonly available materials serve their specific purposes either inadequately or not at all.

- The magnesium perchlorate which is commonly available causes memory effect and affects the repeatability. Another typical effect is that the analysis takes too long and is often not even terminated. This effect also occurs with magnesium perchlorate of suitable quality when it is saturated.
- The commonly available sodium hydroxide binds CO_2 very inadequately at room temperature, whereas the special quality not only perfectly binds CO_2 at room temperature but also contains an indicator, which turns from black to light grey after saturation.

- The inner ends of the glass tubes and the O-rings should be lubricated with high vacuum silicon grease and not with ordinary silicone grease.

The user is free to test commonly available materials; the analyzer will not be damaged. If problems should arise, however, suitable materials, in proper, unsaturated condition, should be used, before calling technical service.
The bottles of chemicals must be closed very properly, immediately after use, in order to prevent the chemicals from saturation by the moisture and CO_2 from the environmental air.

6.2 Reagent tubes – removing and installing

Scalding/burns
Hot furnace / combustion tube / analyzer parts

– Parts of the analyzer can be very hot.
- **Use heat protecting gloves.**

Injuries in the form of cuts and other personal injuries
Danger from glass splitters

– Injuries in the form of cuts can be caused by damaged sample flasks and glass splitters.
- **Replace damaged sample flasks**
- Do not touch glass splitters with your hands.

Danger of bursting

– Defective reagent tubes may cause injuries in the form of cuts and other personal injuries.
- **Before installing the new reagent tubes, check if they are damaged.**
- **Wear protective gloves and safety glasses when installing/removing the reagent tubes.**

Risk of injury to eyes
Chemicals

– When changing the chemicals, the smallest particles of chemicals may be suspended in the air and ca
- **Always wear protective goggles when working with chemicals.**
- **Please heed the safety data sheets for the chemicals used.**

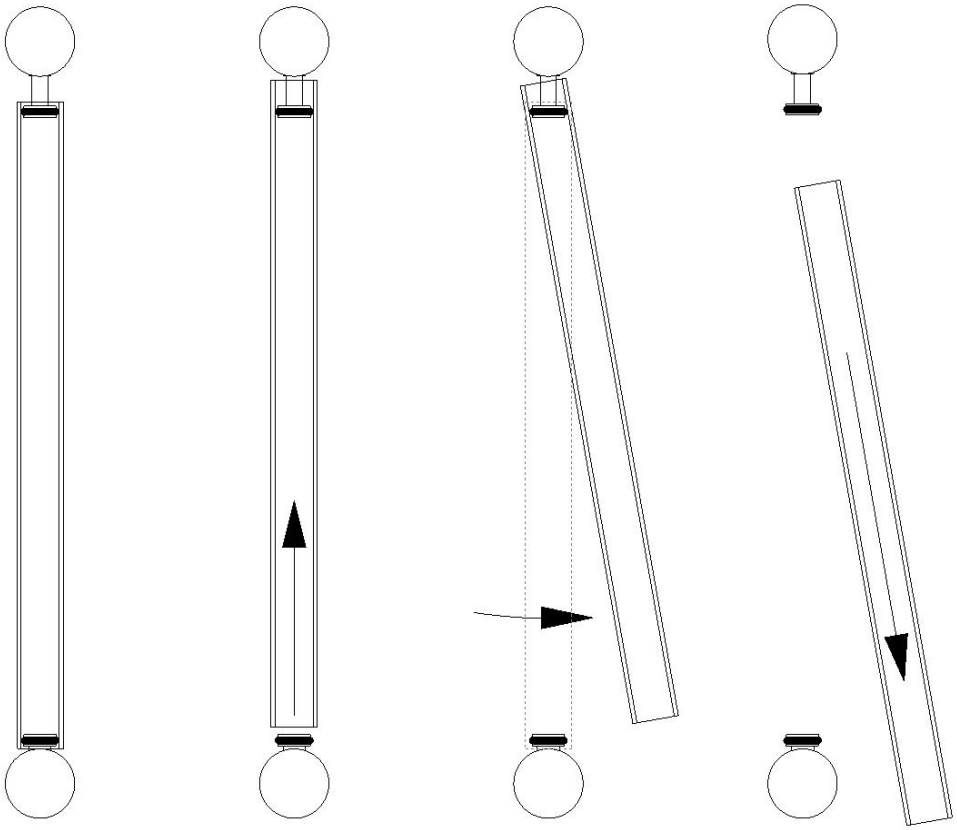


Fig. 13: Reagent tubes installing and removing I

The reagent tubes are first lifted then swung to one side, detached diagonally downwards and emptied.

NOTICE

The dimensions for filling the glass tubes given in the schematic of the chapter Reagent tubes filling should be respected in all cases.

When, for example, there is not enough quartz wool in the bottom of the glass tube, it is possible that dust from magnesium perchlorate can fall through blocking the fitting below causing corrosion along the gas flow system.

NOTICE

Before the reagent tubes are fitted, both, the O-rings and the inner ends of the tubes are lubricated with high vacuum silicon grease.

The copper oxide of the catalyst furnace is replaced after about 2000 analyses. See chapter Reagent tubes filling

It is safer, but not absolutely essential, to switch off the analyzer.

The components are refitted in reverse order.

NOTICE

Only the outside grid of the furnace is to be handled; the quartz reagent tube must only be held at the ends.

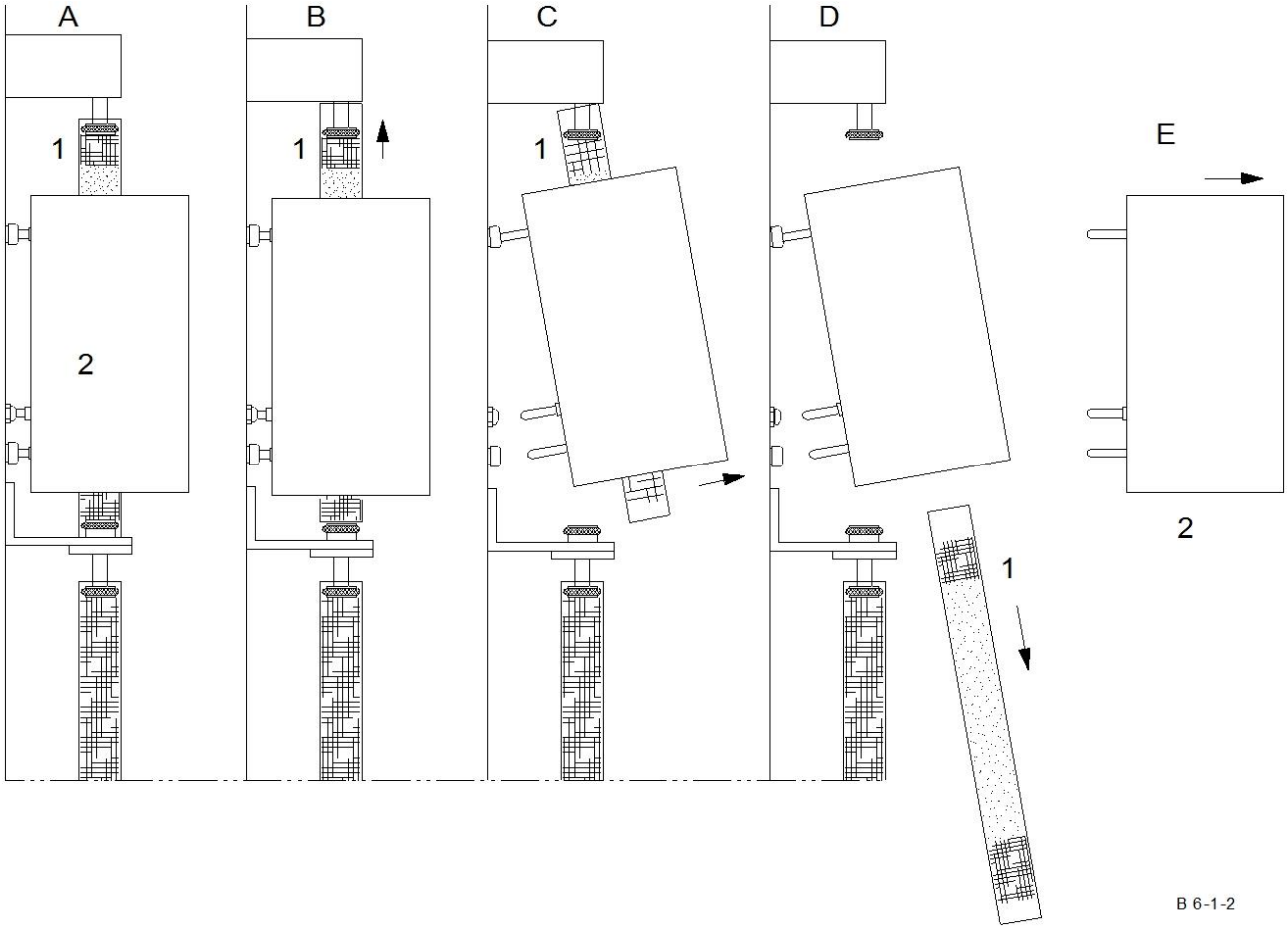


Fig. 14: Reagent tubes installing and removing II

A: Normal position during operation.
B: The quartz tube (1) of the furnace (2) is raised as far as possible.
C: It is then swung out together with the furnace (2).
D: The quartz tube (1) is pulled downwards at an angle.
E: The furnace (2) is removed.
After replacing the copper oxide, the removed components are refitted in reverse order.

6.3 Reagent tubes filling

6.3.1 Chemicals

CAUTION

C9.0076

Scalding/burns
Hot furnace / combustion tube / analyzer parts

– Parts of the analyzer can be very hot.
- **Use heat protecting gloves.**

WARNING

W3.0017

Danger of toxication and personal injuries

– Some chemicals may cause a fatal toxication or dangerous skin corrosion.
- **Refer to the material safety data sheet of the used substances.**

- **Never eat or drink close to the chemical substances.**

C10.0090

CAUTION

Risk of injury to eyes
Chemicals

– When changing the chemicals, the smallest particles of chemicals may be suspended in the air and cause damage to eyes.

- **Always wear protective goggles when working with chemicals.**
- **Please heed the safety data sheets for the chemicals used.**

Magnesium perchlorate (anhydrone)	as moisture absorber
Sodium hydroxide (ascarite)	as CO2 absorber
Copper oxide on rare soils	as oxidizer (CO → CO2)

The reagent tubes are replaced when they are saturated. See chapter General Information .
It is not possible to dry the magnesium perchlorate and use it again, as it is chemically changed after reacting with the moisture. The saturation of the sodium hydroxide changes its color (it turns to light grey).
The magnesium perchlorate is saturated if its particles do not move when tapping on the glass tube. It is essential to change the absorber before it becomes cloggy. The moisture absorber should be checked every 100-200 induction analyses and if necessary, it should be replaced (glass tube underneath the metal filter).
Please refer to the following schematics to identify the glass tubes on the analyzer. In addition to the reagents in the glass tube, fill the bottom end of the tube with glass wool. One should pay attention that the glass wool should be only as thick as necessary. Otherwise the gas flow can be choked. Under no conditions should the amount of glass wool be less than that shown in the following schematics. Otherwise fine particles of magnesium perchlorate can pass through the glass wool layer blocking the hole of the fitting underneath.
It should be pointed out that magnesium perchlorate is a very strong oxidizing material.
NOTICE
There are qualities of chemicals such as Anhydrone, ascarite, copper oxide, Schuetze reagent, tungsten granules, iron chips, copper chips etc. which have been specially developed for combustion analyzers and other analytical instruments. The commonly available materials fulfill their specific purposes either inadequately or not at all.

- The magnesium perchlorate which is commonly available causes memory effect and affects repeatability. Another typical effect is that the analysis takes too long and it is often not even completed. This effect also occurs with magnesium perchlorate of suitable quality when it is saturated.
- The commonly available sodium hydroxide binds CO2 very inadequately at room temperature, whereas the special quality not only perfectly binds CO2 at room temperature but also contains an indicator.
- The glass tubes and the O-rings should be lubricated with high vacuum silicon grease and not with ordinary silicone grease.

The user is free to test commonly available materials; the analyzer will not be damaged. If problems should arise, however, suitable materials, in proper, unsaturated condition, should be used, before calling technical service.
The bottles with chemicals must be closed very tight, immediately after use, so that they do not become saturated with air moisture or CO_2.

6.3.2 Reagent tube filling

CAUTION C11.0076

Scalding/burns
Hot furnace / combustion tube / analyzer parts

– Parts of the analyzer can be very hot.
- **Use heat protecting gloves.**

CAUTION C12.0081

Danger of bursting

– Defective reagent tubes may cause injuries in the form of cuts and other personal injuries.
- **Before installing the new reagent tubes, check if they are damaged.**
- **Wear protective gloves and safety glasses when installing/removing the reagent tubes.**

CAUTION V0095

Injuries in the form of cuts and other personal injuries
Danger from glass splitters

– Injuries in the form of cuts can be caused by damaged glasware and glass splitters.
- **Replace damaged glassware / reagent tubes**

Do not touch glass splitters with your hands.

WARNING W4.0017

Danger of toxication and personal injuries

– Some chemicals may cause a fatal toxication or dangerous skin corrosion.
- **Refer to the material safety data sheet of the used substances.**
- **Never eat or drink close to the chemical substances.**

CAUTION C13.0090

Risk of injury to eyes
Chemicals

– When changing the chemicals, the smallest particles of chemicals may be suspended in the air and cause damage to eyes.
- **Always wear protective goggles when working with chemicals.**
- **Please heed the safety data sheets for the chemicals used.**

The lower end of each glass tube is filled with glass wool, for the chemicals to be retained in the reagent tubes. Do not stuff the glass wool to tight otherwise the gas flow will be blocked. The rest of the tube is filled with reagents as shown in the schematic below. The lower half of the reagent tube for the oxygen pre-cleaning tube is filled with magnesium perchlorate (Anhydrone) and the upper half with sodium hydroxide. The chemicals are separated by a glass wool layer.

Provide sufficient space at both ends of the tube so they can be attached to the glass fittings without blocking the fitting holes. Free inner surfaces at the ends of the tubes serve as sealing surfaces and must be cleaned after filling.

NOTICE

Use quartz wool for the catalyst furnace.

The O-rings also have to be clean. Both the O-rings and the sealing surfaces of the tubes should be greased with silicon grease. This simplifies the fitting and particularly the removal of the tube, and ensures proper sealing.

The O-rings must be cleaned. Both the O-rings as well as the sealing areas of the tube must be greased with high vacuum silicon grease. This will be easier to assemble or disassemble and further it improves the sealing of the glass tubes.

Make sure that the O-rings are completely sealed around the glass tubes, by looking at the imprint of the O-ring on the inner surface of the glass tube. Check whether there are fibers of glass wool trapped between O-ring and glass tube. This causes leakages.

The O-rings are only replaced when they can no longer adequately seal, due to a damage or age. When removing the old O-rings, be ensure that the sealing areas of the fittings are not damaged.

NOTICE

When replacing the O-rings never grease the new O-rings before installation. Otherwise, the O-rings will turn with the glass tube when trying to remove it.

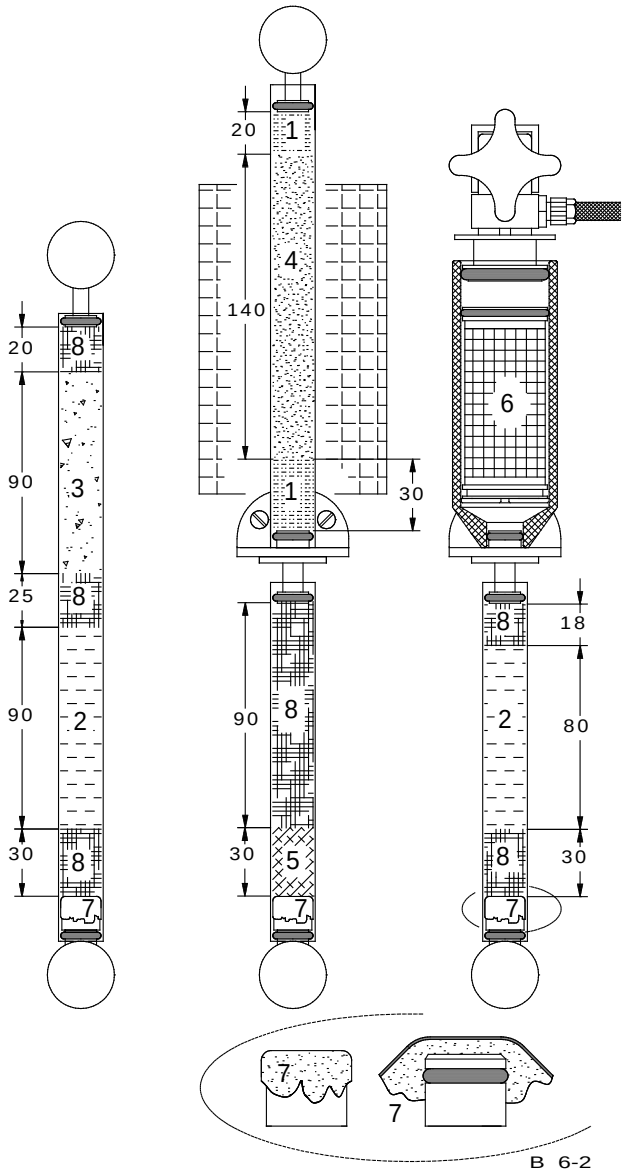


Fig. 15: Glass tubes Schematics
Keep a tolerance of about ± 20 % of the filling lengths of the drawing.

No.	Material	Part No.
1.	Quartz wool	90330
2.	Anhydrone	90200
3.	Sodium hydroxide	90210
4.	Copper oxide	90290
5.	Cotton wool	90340
6.	Metal filter	11105
7.	Paper filter	11185
8.	Glass wool	90331

6.3.3 Oxygen purification furnace quartz tube filling (optional)

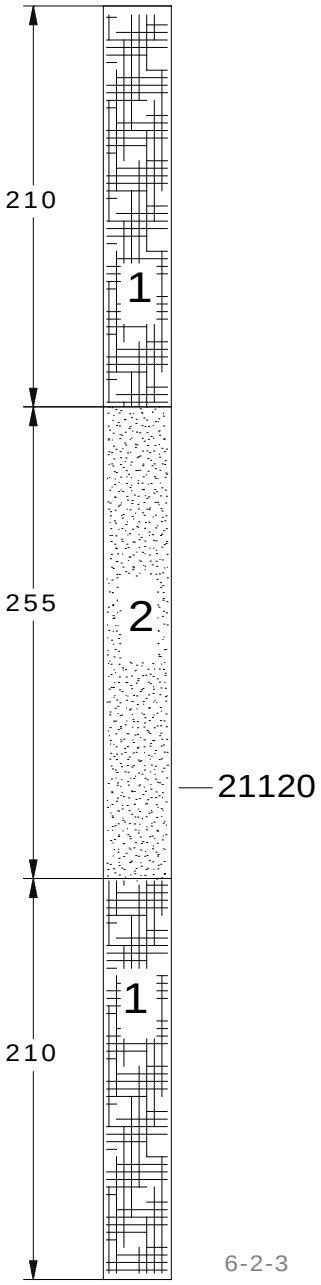


Fig. 16: Oxygen purification furnace glass tube
Keep a tolerance of about ± 20 % of the filling lengths of the drawing.

No.	Material	Part No
1	Quartz wool	90330
2	Copper oxide	90290

6.3.4 Halogen trap filling (optional)

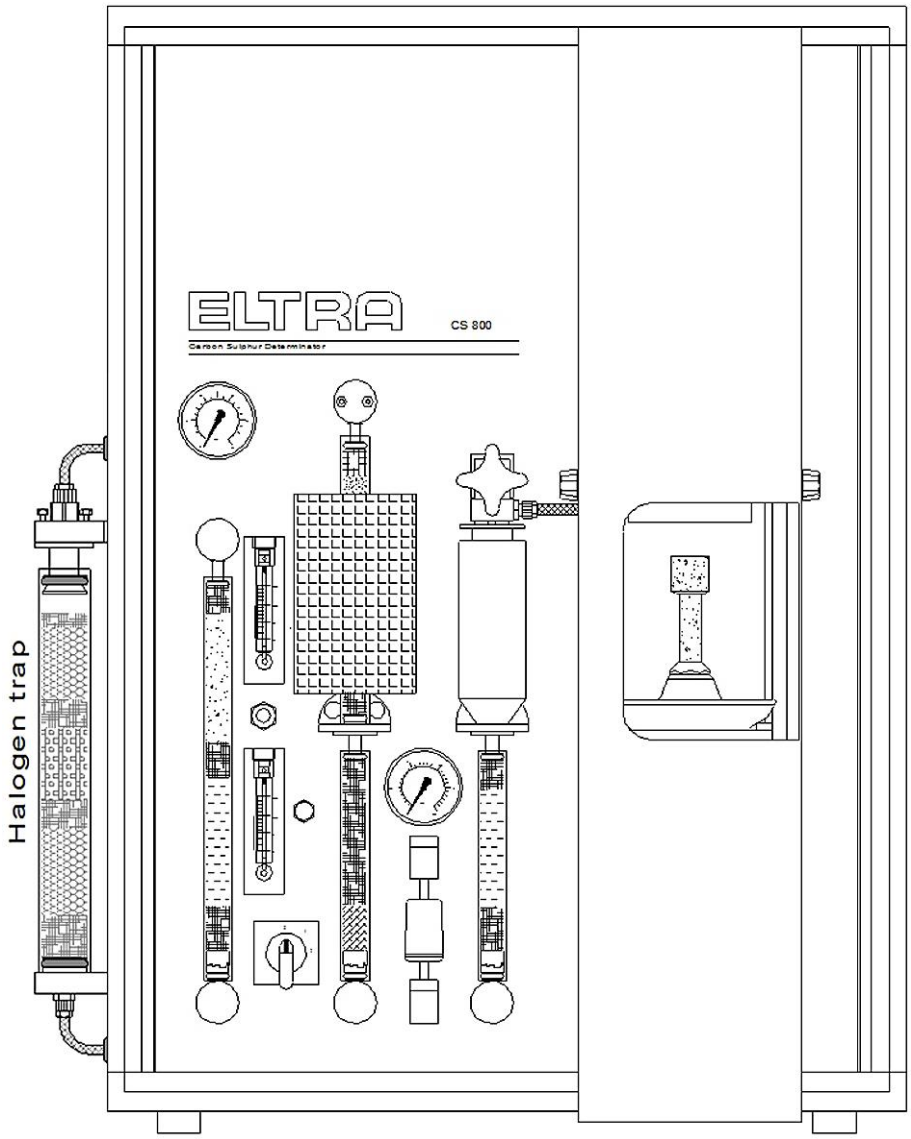


Fig. 17: Halogen trap position

On request the CS-2000 can be supplied with a halogen trap. The glass tube must be filled with halogen trap material.

If the customer orders an analyzer pointing out that he has to analyze materials containing halogens, the analyzer will be delivered with a halogen trap tube attached to the left panel of the analyzer.

Keep a tolerance of about ± 20 % to the filling lengths of the drawing.

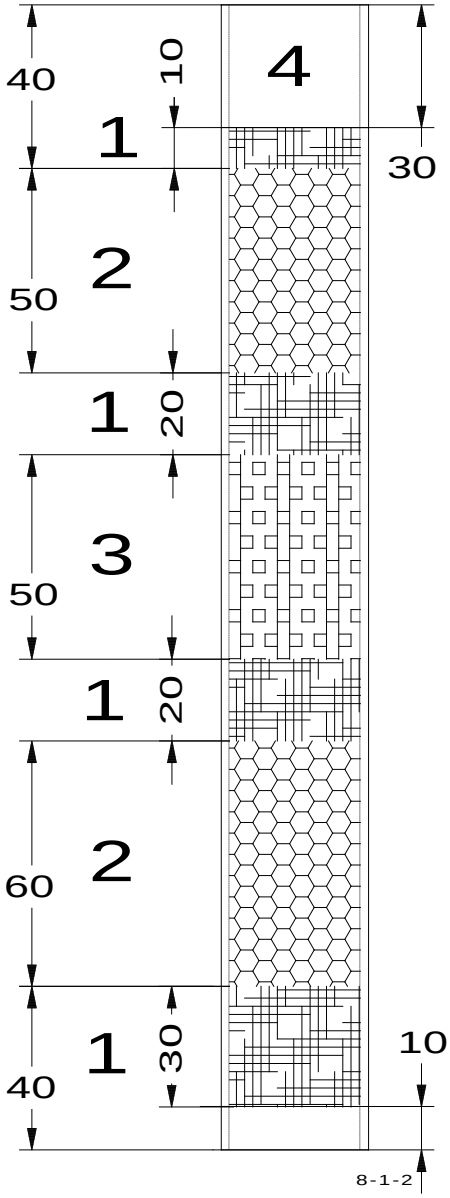


Fig. 18: Halogen trap filling

Material		Part No.
1	Glass wool	90331
2	Halogen trap metal	90235
3	Halogen trap material	90234
4	Glass tube	09090

6.3.5 Paper filter changing

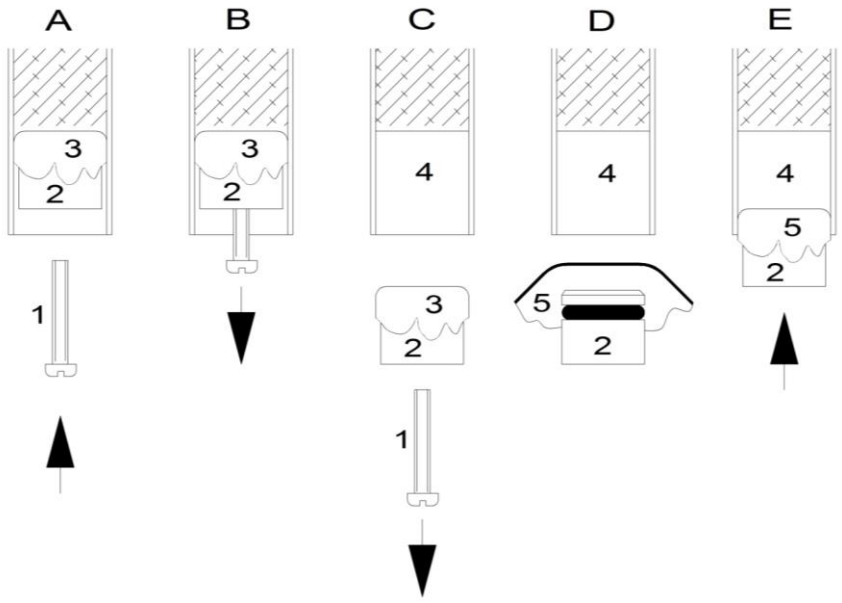


Fig. 19: Paper filter changing

A. Screw an M4 screw (1) into the paper filter holder (2).
B. With this screw, pull the filter holder (2) and the filter (3) out of the reagent tube (4).
C. Remove the screw (1) from the filter holder (2). Remove the old filter (3).
D. A new filter (5) is placed on the filter holder (2) and folded over.
E. The filter holder (2), with the new filter (5) is pushed carefully, back into the reagent tube (4).

The dust filter cartridge filters smallest dust particles from the combustion gases. Its saturation depends on the sample material and its combustion characteristics. The filtering material of a new cartridge is white. Replace the dust filter cartridge when the filtering material shows coloration, or at least every 500 analysis.

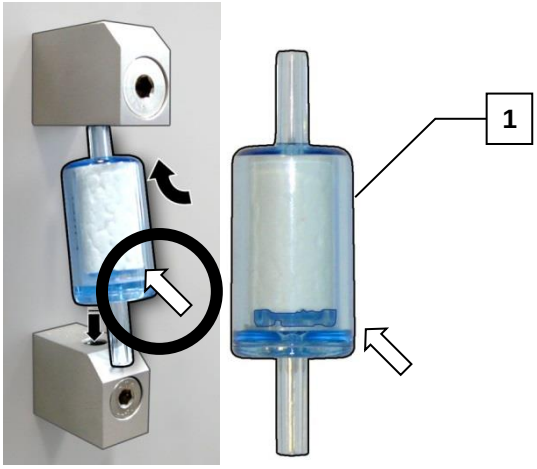


Fig. 20: Dust filter cartridge - inserting

1. Lift the dust filter cartridge (**1**) upwards.
2. Tilt its low end to the front and pull downwards.
3. Install a new cartridge by acting in reverse order.

Take care for the cartridge body to have the smaller diameter up and the bigger down.

6.4 O-rings replacement

CAUTION

C14.0076

Scalding/burns
Hot furnace / combustion tube / analyzer parts

– Parts of the analyzer can be very hot.
- **Use heat protecting gloves.**

CAUTION

V0062

Injuries in the form of cuts and other personal injuries
Danger from glass splitters

– Injuries in the form of cuts can be caused by damaged sample flasks and glass splitters.
- **Replace damaged sample flasks**
- Do not touch glass splitters with your hands.

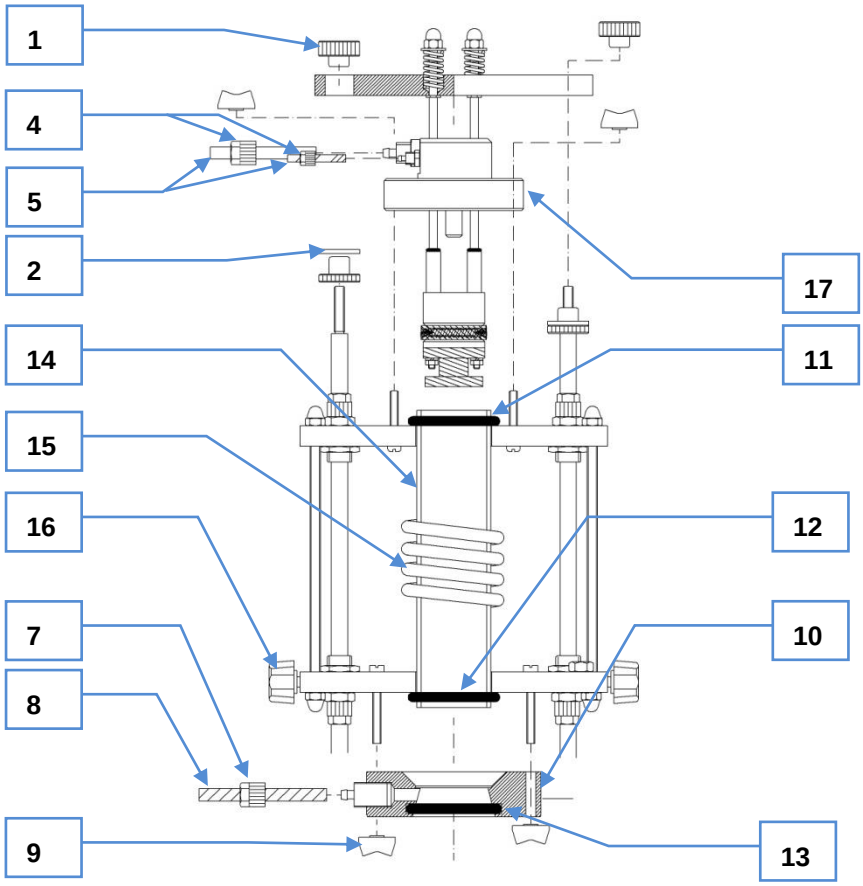


Fig. 21: furnace details

1	Knurled nut
2	Washers
3	Wing nuts
4	Nut for gas inlet tube
5	Gas inlet tube
6	Mounting
7	Nut for gas outlet tube
8	Gas outlet tube
9	Wing nuts
10	Lower furnace lock
11	Upper o-ring for combustion tube
12	Lower o-ring for combustion tube
13	O-ring for lower furnace lock
14	Combustion tube
15	Induction coil
16	Nuts for furnace housing
17	Upper furnace lock

6.4.1 Replacing the o-rings 11 and 12 for combustion tube:

- Remove the furnace housing by just loosening the nuts (16).
- Open the furnace.
- Unscrew the knurled nuts (1) and washers (2).
- Unscrew the wing nuts (3).
- Unscrew the nuts (4) and detach tubes (5).
- Remove the furnace cleaning system, by pulling up the mounting (6).
- Unscrew the nut (7) and detach the tube (8).
- Unscrew the wing nuts (9) and pull down lower furnace lock (10).
- Now the O-rings (11) and/or (12) can be removed and replaced. Apply a thin layer of grease on the inner surface of the new O-rings, before mounting them. Apply a thin layer of grease on the outer surface of the combustion tube, where the new O-rings will be placed.
- Reinstall in reverse order.

6.4.2 Replacing the o-ring 13 for lower furnace lock

- Remove the furnace cover by just loosening the nuts (16)
- Unscrew the nut (7) and detach tube (8)
- Unscrew the wing nuts (9) and pull down lower furnace lock (10)
- Remove the O-ring (13) with a screwdriver; insert a new one without greasing it.
- Reinstall in reverse order.

6.4.3 Replacing the o-rings for furnace seal

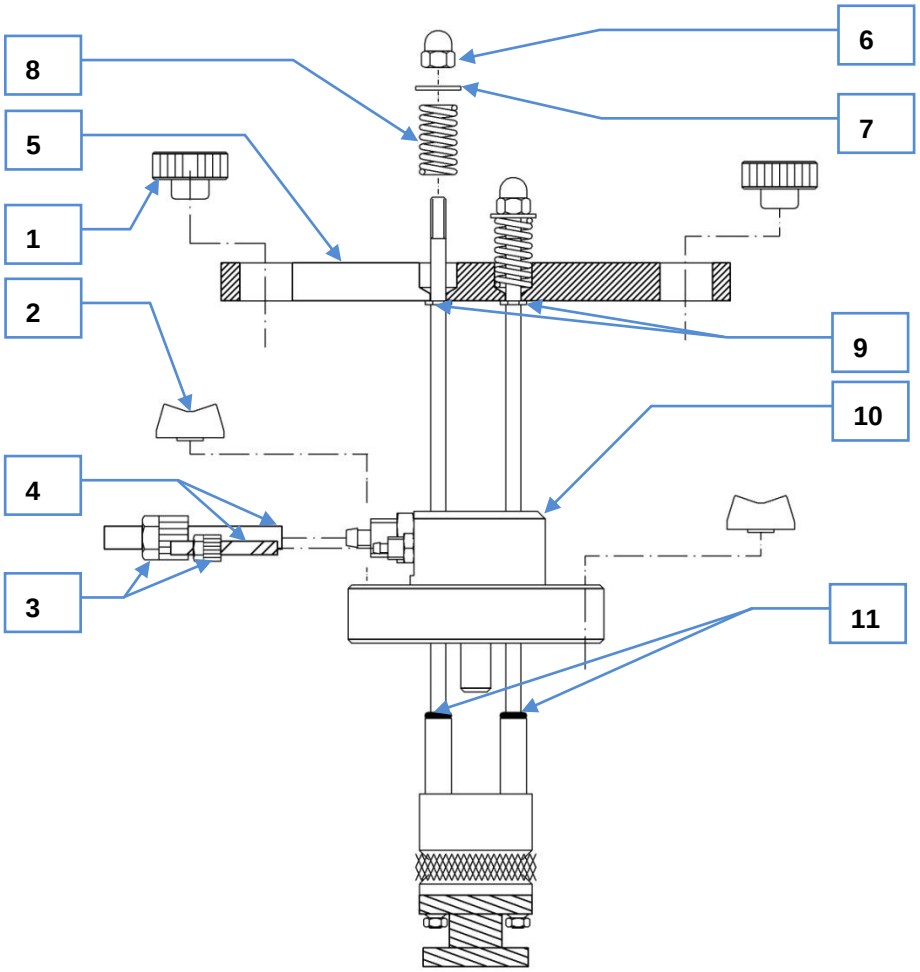


Fig. 22: Cleaning mechanism details

- Unscrew the knurled nuts (1).
- Unscrew the wing nuts (2).
- Unscrew the nuts (3) and gas inlet tubes (4).
- Remove the furnace cleaning system, by pulling up the bar (5).
- Unscrew the nuts (6) and remove the washers (7) and springs (8).
- Remove the bar (5).
- Remove the circlips (9).
- Remove the upper furnace lock (10).
- Remove and replace the O-rings (11) do not grease the O-rings!
- Reinstall in reverse order.

The O-rings are only replaced when they can no longer adequately seal, due to a damage or age. When removing the old O-rings, be ensure that the sealing areas of the fittings are not damaged. The sealing surfaces of the o-rings, on the rods and inside the furnace lock (10), must be cleaned to be free of grease and dust.
Don’t grease these O-rings.

6.5 Furnace cleaning brush - replacing

CAUTION

C15.0076

Scalding/burns
Hot furnace / combustion tube / analyzer parts

- Parts of the analyzer can be very hot.
- **Use heat protecting gloves.**

The furnace is equipped with an auto-cleaning system. This mechanism contains a brush, which cleans the quartz tube (combustion tube).
For replacing the brush during working time, it is advisable to set the power switch to position 1. If the replacement is done during a long maintenance break, the power switch can be of course at position 0.

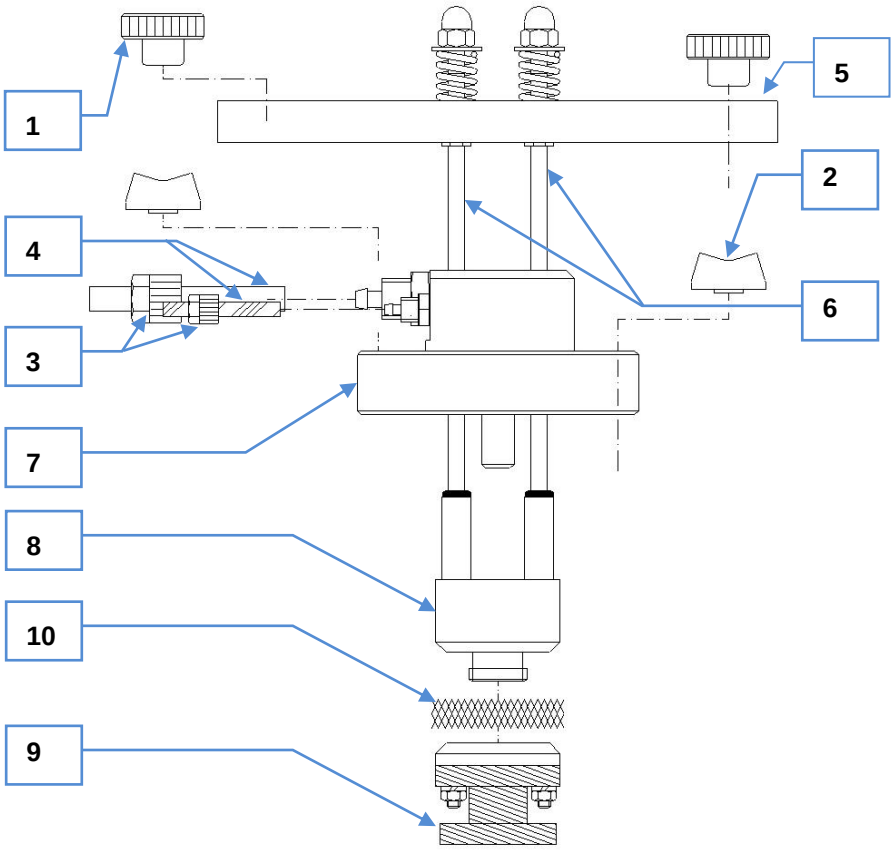


Fig. 23: Furnace cleaning brush-replacing

- Loosen the cover knobs and remove the cover.
- Open the furnace.
- Remove the knurled nuts (1).
- Unscrew the wing nuts (2).
- Loosen the nuts (3) and detach the tubes (4).
- Remove the furnace cleaning system, by lifting up the mounting (5).
- Hold tight the brush holder (8) and unscrew the heat shield (9), together with its brass ring.
- Remove and replace the brush (10).
- Reassemble in reverse order

NOTICE

It is absolutely important to hold the brush holder (8) and not the bar (5), when unscrewing the heat shield (9), otherwise the rods (6) will bend.

6.6 Dust trap cleaning

CAUTION

C16.0076

Scalding/burns

Hot furnace / combustion tube / analyzer parts

– Parts of the analyzer can be very hot.

- **Use heat protecting gloves.**

The dust from the furnace is trapped in the metal dust filter (2). The dust filter needs to be cleaned after about 100 analyses.

Make sure that the filter is absolutely dry after ultrasonic cleaning. The porosity of the filter is 10 microns only and it is impossible to recognize whether the inside of the filter is dry, by simply looking into it. Therefore it is advisable to have a second filter, in order to use it while drying the other one. The filter can be dried with hot air. The replacement of the dust filter (2) takes only about 5 seconds.

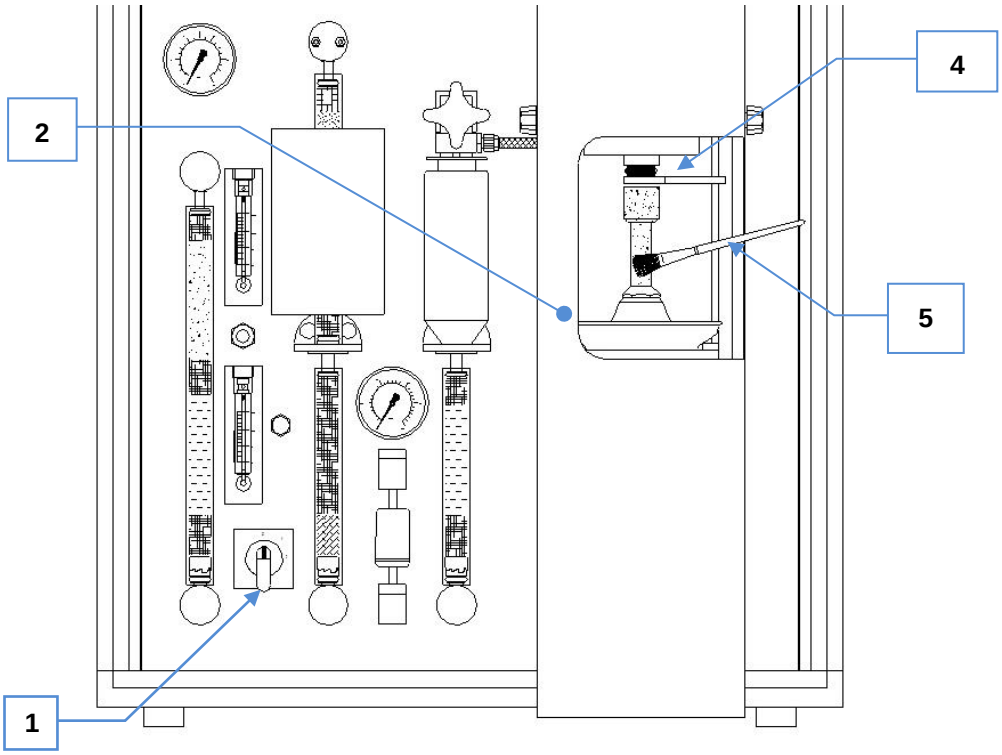


Fig. 24: Dust trap

- The main switch (1) can stay at position 2.
- The oxygen does not need to be turned off, but only the furnace has to be opened.
- The heat shield (4) and the pedestal (5) can occasionally be cleaned.

Remove the dust trap (2), as follows:

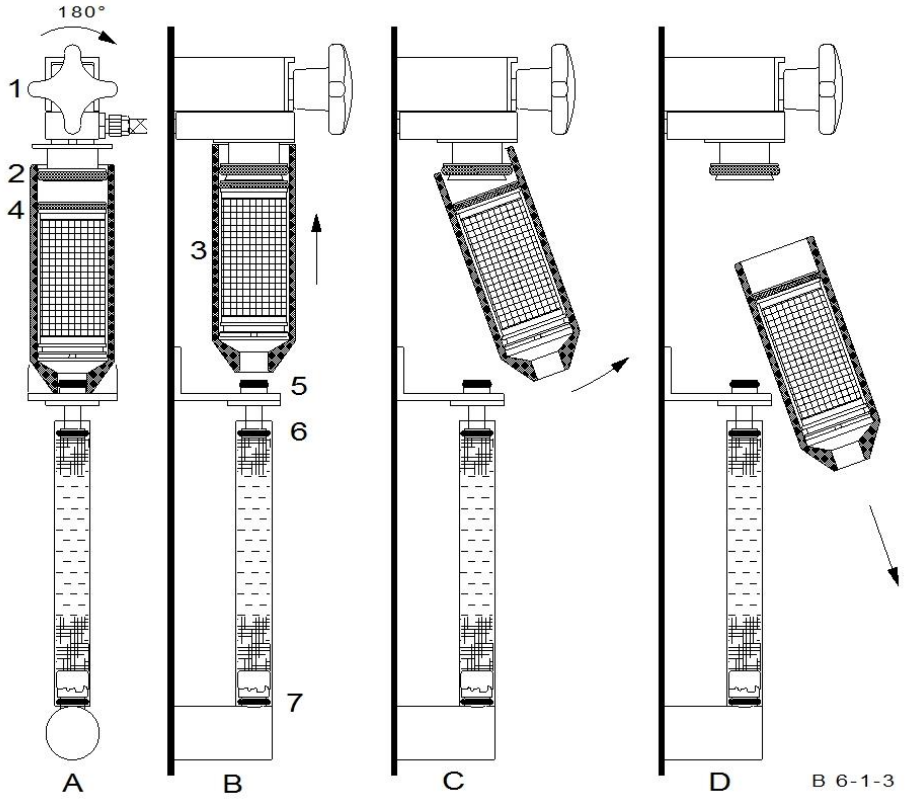


Fig. 25: Dust trap removing

A: The cock (1) is rotated by 180°, so that the O-ring (2) loosens.
B: The dust trap (3) is raised as far as it will go.
C: Then it is swung to the side and
D: Detached downwards at an angle.

- Clean the dust trap (3).
- Reinstall in reverse order after cleaning.

6.6.1 Fast filter cleaning

– once every 200 analyses when using tungsten accelerator
– once every 100 analyses when using tungsten and Iron

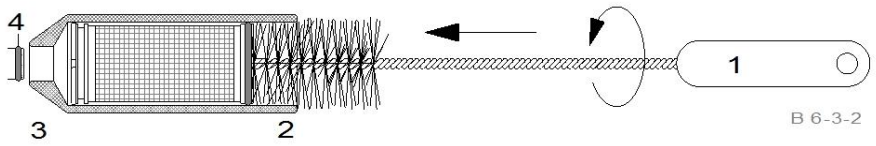


Fig. 26: Dust trap: fast cleaning

- Clean the dust using the brush (1) delivered with the analyzer.
- Rotate in only one direction.
- Clean the upper end of the filter housing (2).

NOTICE

Grease only the lower end of the filter housing (3) and the lower O-ring (4). The upper end of the filter housing (2) and the O-ring of the upper sealing mechanism should remain clean and absolutely free of grease.

6.6.2 Thorough cleaning

– once every 1000 analyses when using tungsten accelerator
– once every 500 analyses when using tungsten and Iron

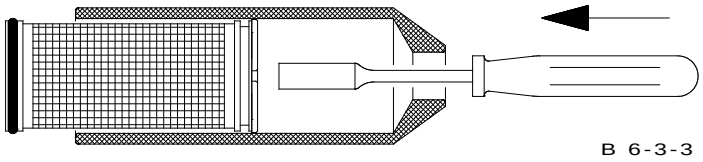


Fig. 27: Dust trap: disassembling

- Remove the metal filter out of the filter housing.
- Perform a preliminary cleaning, by using the brush.
- Clean the metal filter in the ultrasonic cleaner.
- Dry and, if necessary for assembling, lubricate the 0-ring.
- Clean the upper end of the filter housing (2) from any grease.

NOTICE

When reinstalling the filter in the filter housing, the O-rings must be correctly installed otherwise the gas flow will be completely blocked.
Outer O-ring on top, inner O-ring to the bottom.

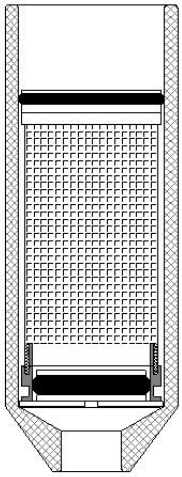


Fig. 28: Dust trap: outer and inner o-rings

6.7 Oxygen purification furnace refilling

C17.0076

CAUTION

Scalding/burns
Hot furnace / combustion tube / analyzer parts

- Parts of the analyzer can be very hot.
- **Use heat protecting gloves.**

C18.0090

CAUTION

Risk of injury to eyes
Chemicals

- When changing the chemicals, the smallest particles of chemicals may be suspended in the air and cause damage to eyes.
- **Always wear protective goggles when working with chemicals.**
- **Please heed the safety data sheets for the chemicals used.**

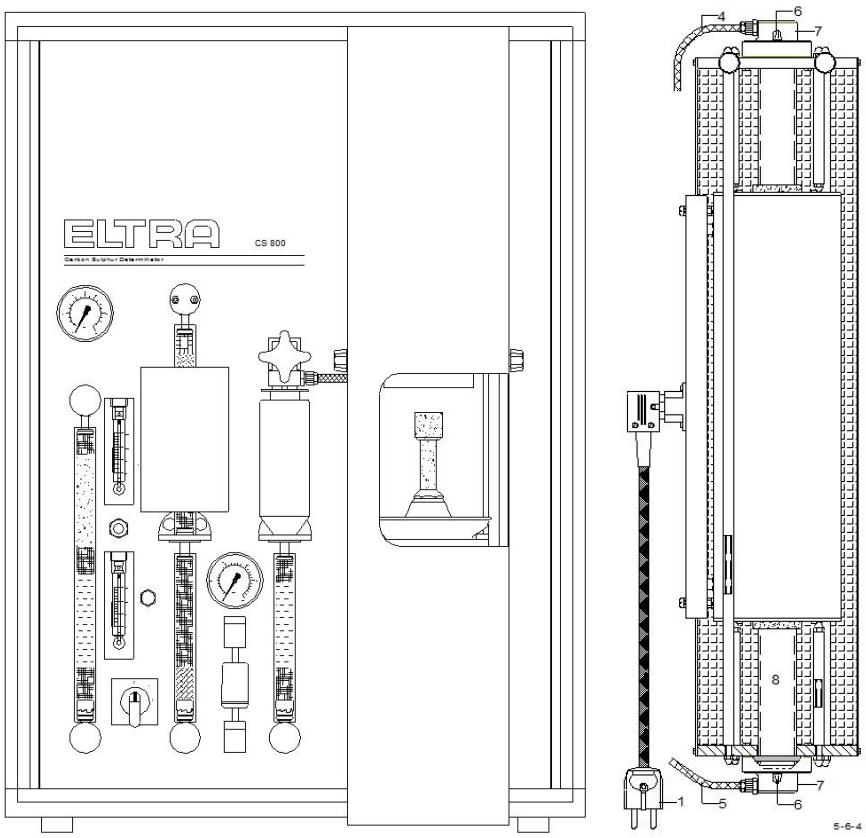


Fig. 29: Oxygen purification furnace

- Disconnect the power (1).
- Close the oxygen supply (bottle).
- Keep the power switch (2) of the analyzer to position 1.
- Wait until the pressure on the oxygen gauge (3) drops to zero.
- Disconnect the oxygen tubes (4) and (5) from the purification furnace.
- Lift the furnace and remove it from the analyzer.
- Place the furnace in horizontal position.

- Unscrew all four nuts (6).
- Remove the two parts (7).
- Remove the glass tube (8) by pulling it horizontally.
- Empty and refill. See chapter Oxygen Purification furnace quartz tube
- Install in reverse order.

6.8 Combustion tube replacement

CAUTION

C19.0076

Scalding/burns

Hot furnace / combustion tube / analyzer parts

– Parts of the analyzer can be very hot.

- **Use heat protecting gloves.**

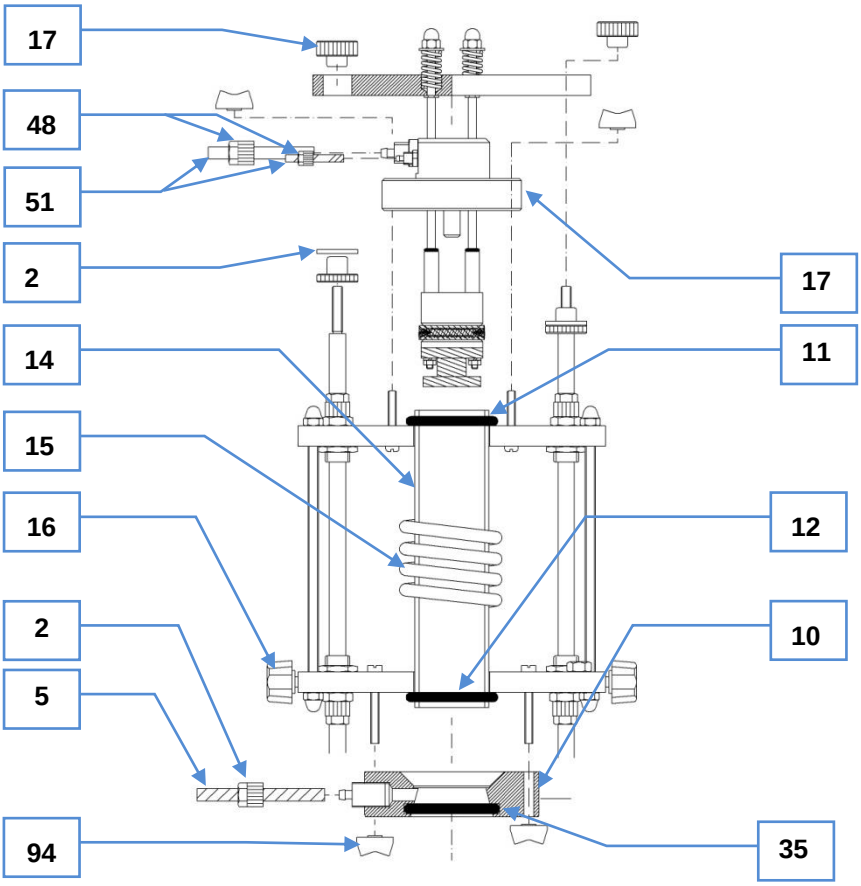


Fig. 30: Induction furnace details

1	Knurled nut
2	Washers
3	Wing nuts
4	Nut for gas inlet tube
5	Gas inlet tube
6	Mounting
7	Nut for gas outlet tube
8	Gas outlet tube
9	Wing nuts
10	Lower furnace lock
11	Upper o-ring for combustion tube
12	Lower o-ring for combustion tube
13	O-ring for lower furnace lock
14	Combustion tube
15	Induction coil
16	Nuts for furnace housing
17	Upper furnace lock

- Remove the furnace cover by just loosening the nuts (16).
- Unscrew the knurled nuts (1) and washers (2).
- Unscrew the wing nuts (3).
- Unscrew the nuts (4) and detach the tubes (5).
- Remove the furnace cleaning system, by pulling the mounting (6).
- Unscrew the nut (7) and the detach tube (8).
- Unscrew the wing nuts (9) and pull down lower furnace lock (10).
- Pull-off the lower O-ring (12) from the combustion tube, remove the combustion tube (14) by pulling it up; remove the upper O-ring (11).
- Apply a thin layer of grease on the inner surface of the new O-rings (11) and (12), before mounting them. Apply a thin layer of grease on the outer surface of the combustion tube, where the new O-rings will be placed.
- Reinstall in reverse order.

6.9 Generator tube replacing

For the replacement of the generator tube a separate manual is available.
Please contact the service, see Chapter 1, contact information.

6.10 Combustion coil replacing

For the replacement of the combustion coil a separate manual is available.
Please contact the service, see Chapter 1, contact information.

6.11 Pedestal removing

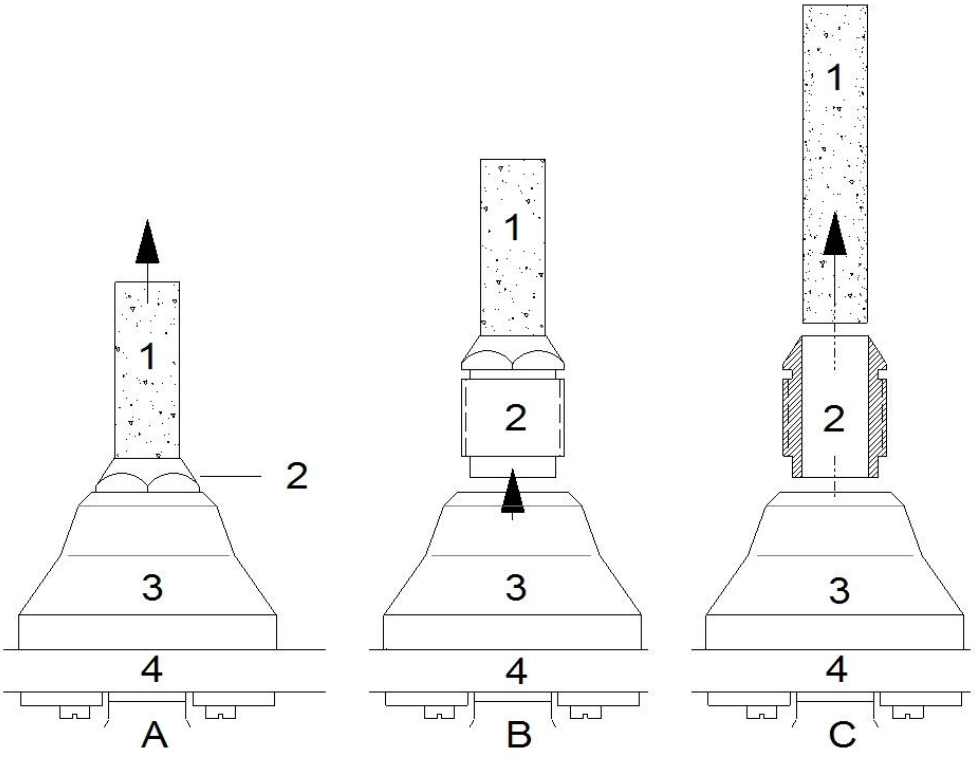


Fig. 31: Pedestal removing

A: Remove the pedestal (1) from the furnace closing cone by lifting.

B: If the pedestal cannot be easily lifted, unscrew with a 24 mm wrench the nut (2) from the cone (3).

C: This will give access to the bottom off the pedestal allowing its removal. When fitting the nut (2) to the cone (3), ensure there is no dust in the threads of the two parts. A vacuum cleaner can be used to clean the threads prior to reassembling.

6.12 Gas leaks checking

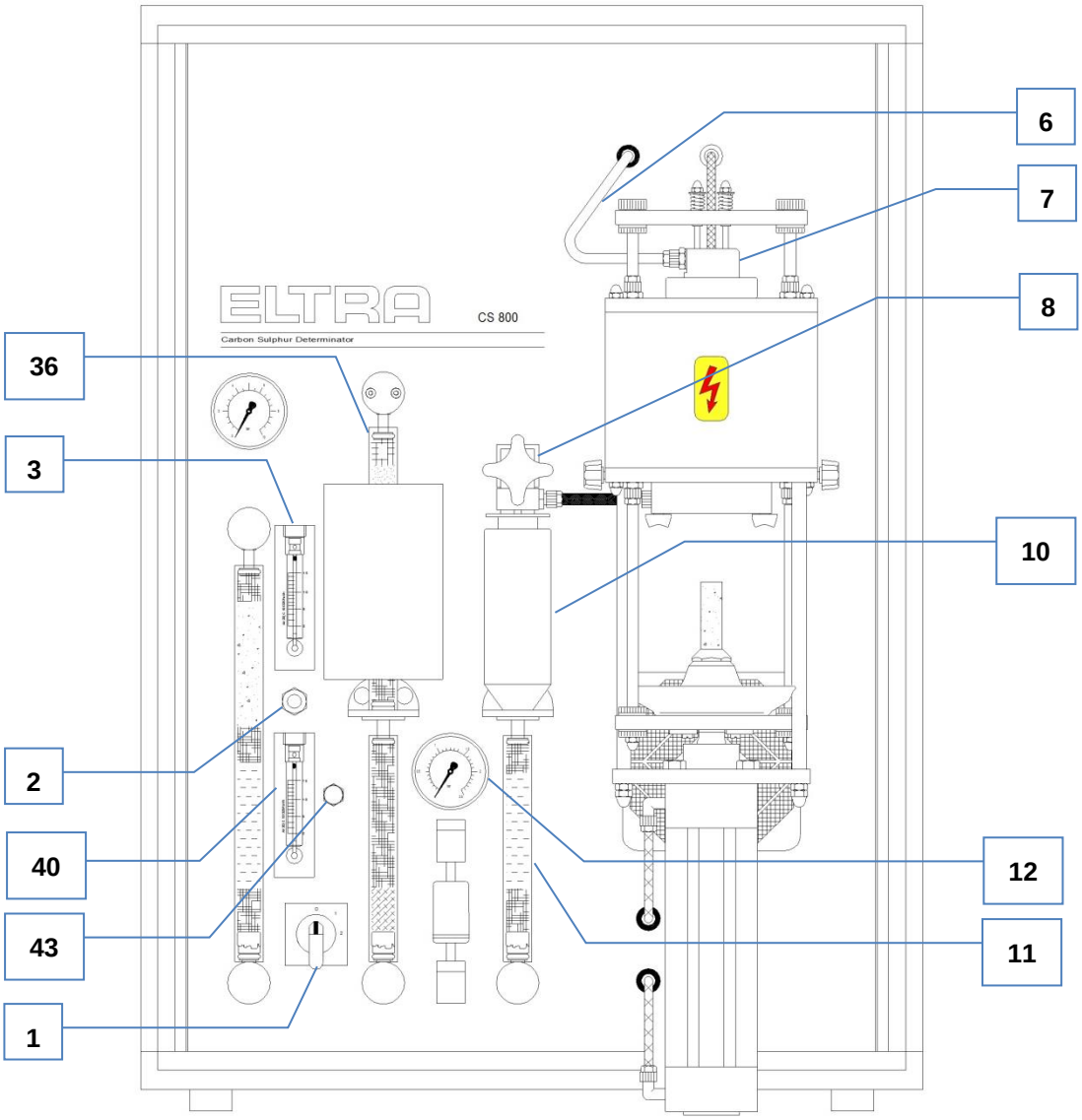


Fig. 32: Gas leaks check-Analyzer

- Set the power switch (1) to pos. 2.
- Close the furnace (piston up).
- Press the button (43) and keep it pressed. The entire system is then checked for leaks.
- After about 5 seconds of initial pressure drop, the pressure on the gauge (12) remains constant, which means there is no leakage in the gas flow system. The leakage test is completed. The gas system is seal.
- In case there is a continuous pressure drop, then release the button (43), open the furnace. Then press and hold the button (43) again.
- If the pressure remains constant after an initial drop, then the fault is in the furnace area, including the metal dust filter.
- If the pressure still decreases, then the leakage is somewhere in the gas flow system outside the furnace area.
- Read the service manual or contact the local Eltra agent or contact Eltra GmbH directly.

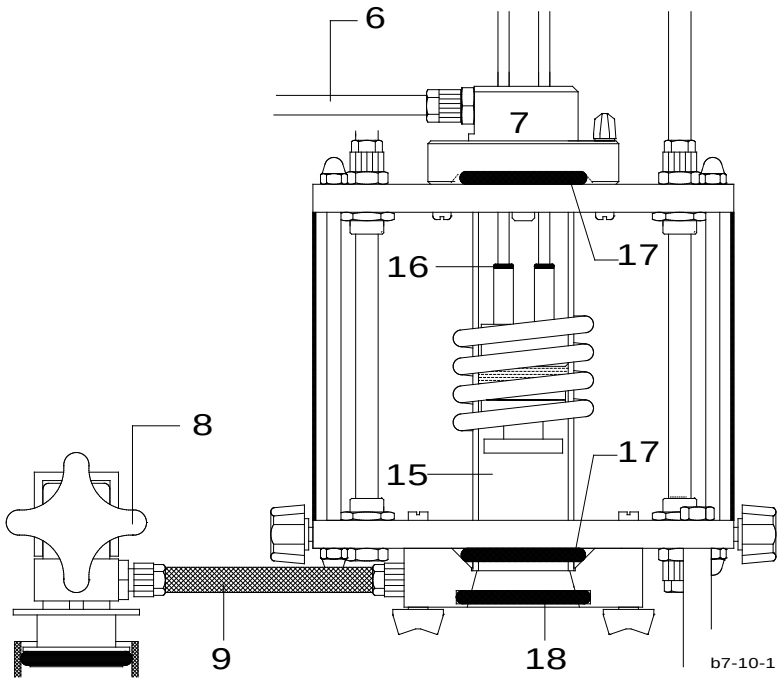


Fig. 33: Gas leaks check-furnace

- Release the button (43), close the furnace, squeeze the tube (6) tight and press and hold the button (43).
- If the pressure on gauge (12) remains constant, then the furnace has to be checked for leaks.
- If the pressure shown on gauge (12) drops, then the leakage must be somewhere before the furnace, between oxygen inlet and furnace.

6.12.1 Leaks in the furnace inlet system

- After following the above instructions, check the inlet tubes (6) for leakage

6.12.2 Leaks in the furnace

- After following above instructions, close the furnace, squeeze tight the tube (9), press and hold the button (43), observe the pressure gauge (12).
- If the pressure drops, then the furnace is leaking. Check whether the O-rings (16), (17) and (18) are dirty or defective. See chapter O-Rings replacing.
- Check whether the combustion tube (15) is broken or cracked. See chapter Combustion tube replacing.
- If the pressure remains constant, then the leakage must be after the furnace.

6.12.3 Leaks in the furnace outlet system

After following the instructions in the section Leaks in the furnace, check if the handle (8) is properly shut, or else there will be a major gas leakage from the dust filter. Check the dust trap (10) and the glass tube (11) for leakage.

7 Function description

7.1 System overview

The CS-800 incorporates the latest in combustion technology. It is designed for the rapid simultaneous determination of carbon and sulfur in steels, cast iron, copper, alloys, ores, cement, ceramics, carbides, soils, and minerals, sand, glass. The analysis of organic materials like Coal, coke, oil, ashes, catalysts, lime, gypsum, rubber, leaves, soot, tobacco, waste, and other solid materials is also possible, however with reduced accuracy.
For optimum analysis of organic materials, there are analyzers available, employing resistance furnaces, like the CS-580 and Helios.
In case highest accuracy for the analysis of both, inorganic and organic materials is required, Eltra offers the model CS-2000 which employs two furnaces, an induction furnace for inorganic analysis and a resistance furnace for organics.
The CS-800 can be supplied with up to four independent infrared cells. The most common configuration of the CS-800 for metal analysis is with two IR-cells for carbon and one IR-cell for sulfur.
For general purposes the configuration is with two carbon and two Sulfur cells, offering optimum precision for the analysis of high and low levels of carbon and sulfur in a wide variety of materials. The change over from the low to the high range is done automatically during the analysis and doesn't require any pre-setting by the operator.

7.2 Measuring principle

The measuring method is based on sample combustion and measurement of the combustion gases using infrared absorption.
During combustion, the carbon and sulfur components present in the sample are oxidized to CO2 and SO2.
Combustion is obtained by supplying oxygen, which at the same time acts as carrier gas. An electronic flow controller keeps the flow quantity at a constant level of 180 l/h (unless the analyser is a special model).
Dust traps and moisture absorber ensure that a dry, dust free gas mixture is supplied to the infrared cells.
The output signals of the infrared cells are selective and correspond to the CO2 and SO2 concentrations in the gas mixture. They are electronically linearized and integrated, divided by the sample weight and displayed as % C and % S on the PC screen.
Since the sample weight is taken into account, the results do not depend on the sample weight. For this purpose, the sample is weighed before being analyzed and the sample weight is transferred to the PC. If necessary, blank values can also be entered; the software takes them into account when determining the results.
The CS-800 is PC controlled using the "UNI" software developed by Eltra for combustion analyzers. For information about this software, please, refer to the Help-function in this manual.
The graphical presentation of the detector signals (peaks) is shown on the PC's screen during and after analyses. At the end of analysis the results are displayed as well. All analysis data for every finished analysis are saved in the PC and remain available for review, results recalculation, calibration and further processing. They can be printed out on a printer or exported to another software, if necessary

7.3 Gas flow system

The oxygen supply is connected to the inlet of the gas flow system. Pure oxygen is available in steel bottles. A 99.5% purity is fully sufficient. Any CO2 or H2O which may be contained in the oxygen is retained in the CO2 and H2O trap. The upper half of the trap is filled with CO2 absorber and the lower half with H2O absorber.
Magnesium perchlorate (anhydrone) acts as H2O absorber. Sodium hydroxide acts as CO2 absorber, preferably with an indicator, so that the degree of saturation can be seen from the coloration.
The oxygen inlet pressure should be 2 to 4 bar (30 to 60 psi), which is then regulated inside the analyzer to 1.5 bar (22 psi), and shown on the pressure gauge. Any pressure fluctuation of the external oxygen supply has no influence on the accuracy of the measurements.
The oxygen then enters the furnace after passing thru the oxygen valve. A pressure switch reports whether there is sufficient pressure in the furnace and whether the furnace is closed, in order to start the analysis cycle
The combustion gases from the furnace, flow first thru a dust trap and then through a H2O absorber. Via the bypass valve, they reach the electronic controlled flow regulating valve V6, which is the adjusting element of the electronic flow regulation.
Then, the gases pass through the SO2-selective cells. Any CO, that may be present, is oxidized to CO2 in the catalyst furnace, which is filled with copper oxide. Unwanted SO3, which results thereby from SO2, is retained in the SO3 trap which is filled with cotton wool.
A flow meter displays the gas flow. The flow rate is set internally to 180 l/h. The exact level of the flow is not important, since the calibration of the analyzer takes this into account.
Very important is that the flow rate is constant. An electronic board ensures this. A slight deviation from the set value or a conflict, as with mechanical regulators, cannot arise. The regulation either functions precisely, in which case the flow rate is correct or, in the event of a defect, the flow rate is completely blocked or extremely high.

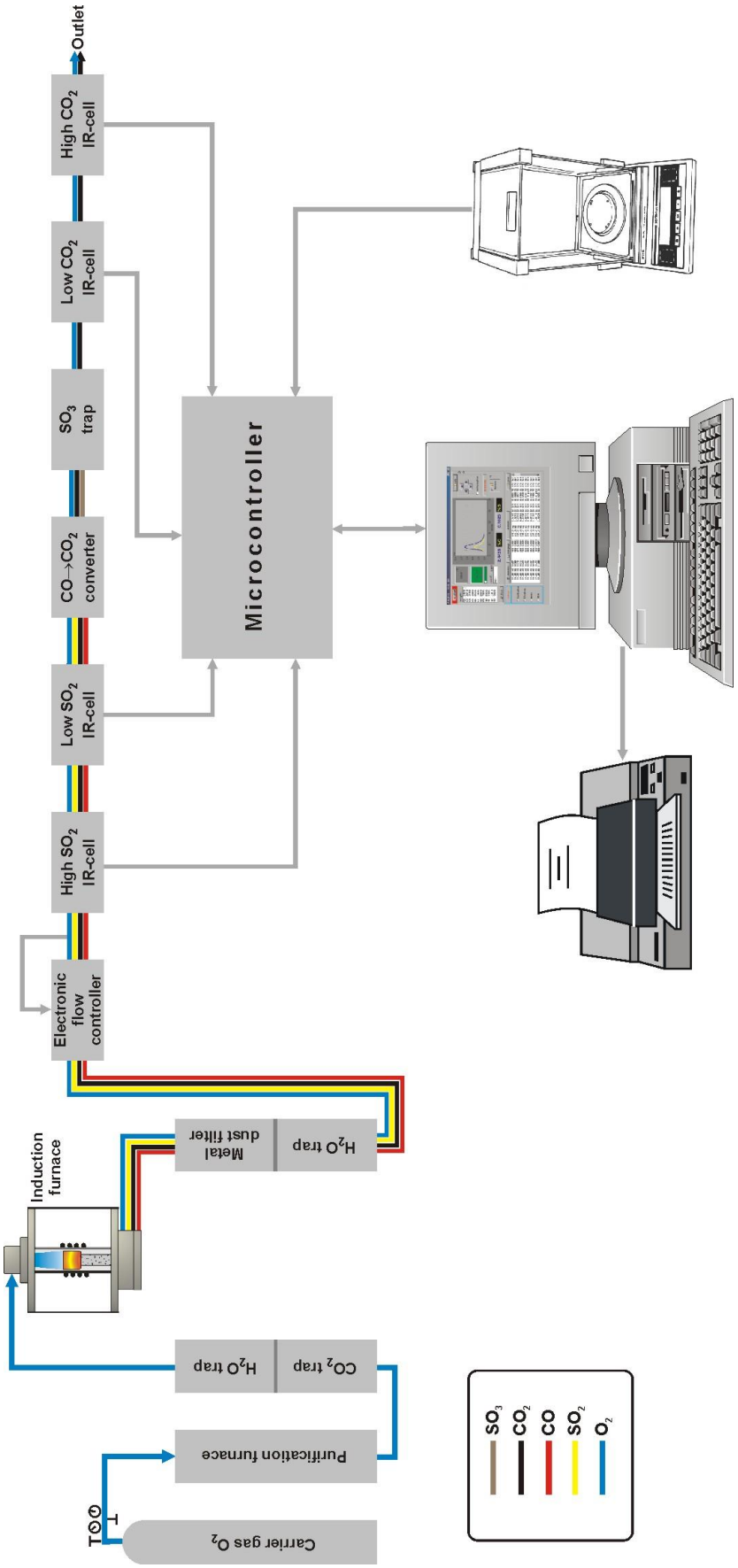


Fig. 34: Gas flow system

7.4 Infrared cell

The measuring principle is based on the infrared radiation absorbing property of many gases. Each of these gases absorbs specific characteristic spectral wavelengths of infrared radiation. The absorption spectrum is determined by the number, configuration and type of the atoms in the gas molecules.

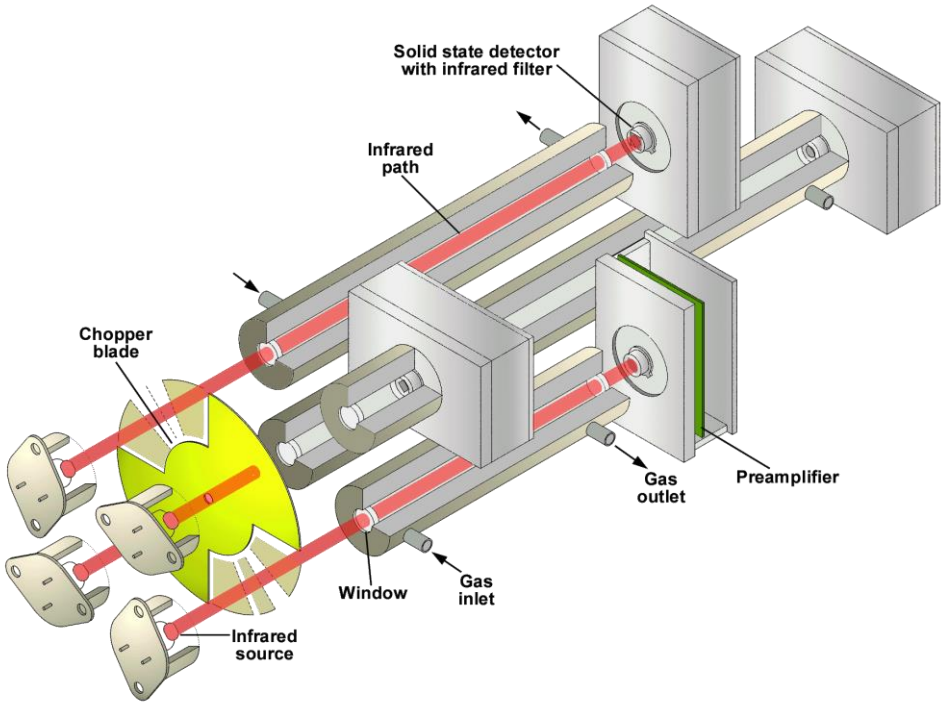


Fig. 35: Infrared cell

An infrared source is electrically heated emitting wide band infrared radiation. The radiation beam is interrupted by a rotating chopper blade, resulting in alternating light. The rotary speed of the chopper is crystal controlled, so that the chopper frequency is very stable. The infrared radiation then passes through the measuring IR-paths, through which a mixture of combustion gases and carrier gas flows.

Depending on the composition of the gas mixture, certain frequencies of the infrared spectrum are absorbed. The rate of absorption depends on the concentration of the gases.

As the infrared beam leaves the IR-path, it passes through an infrared filter, which allows only a certain narrow band infrared radiation to pass. This narrow band must correspond to the IR wavelength for which the gas to be detected has its maximum absorption capability.

The intensity of the radiation after the filter thus corresponds to the concentration of a specific gas in the path. The beam finally strikes a solid state infrared sensor, giving an electrical signal corresponding to the intensity of the beam.

As the beam is interrupted by the rotating chopper, the detector receives an alternating radiation creating an AC electrical signal. Temperature and aging influences of the detector, as well as noise are thereby strongly reduced.

The signal obtained is amplified, rectified and passed thru a low pass filter so that it leaves the infrared cell as a DC voltage.

The infrared cells utilize solid state sensors combined with infrared filters. The infrared cell module can be equipped with up to four independent infrared cells.

The lengths of all four cells can be individually optimised to obtain maximum precision for the target analysis levels of each customer. Each of the cells can be installed with infrared absorption lengths ranging from 1 mm to 320 mm. The infrared cell rack is temperature controlled so that the sample gas flowing through it is kept at a constant temperature.

The infrared cell rack is temperature controlled, so that the sample gas which flows through it, is kept at a constant temperature.

7.5 Furnace

The combustion is carried out in a high frequency induction furnace. The sample is inserted into the induction coil of the oscillating circuit of the pedestal, then heated by high frequency induction and combusted by supplying oxygen.
By starting the analysis, the HF generator's high voltage supply is switched on. Inside the coil, a quartz tube is fitted to an upper and a lower holder. The gas flows downwards. The furnace inlet leads through a lance, which blows the oxygen for combustion directly into the crucible and onto the burning sample. When the sample is inserted into the furnace by the pedestal, the lower opening of the quartz tube is closed with the sealing cone.

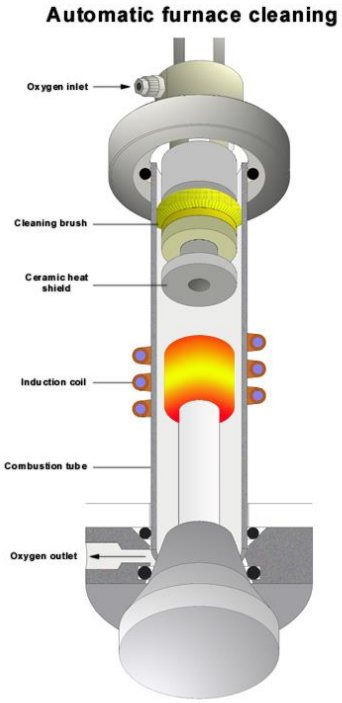


Fig. 36: Automatic induction furnace cleaning
The users of carbon and sulphur analyzers with induction furnaces know that dust accumulates during combustion (mainly of iron and tungsten oxides) in the combustion chamber.
The CS-800 furnace is cleaned automatically after each analysis, thus ensuring repeatable and accurate results. The standard cleaning apparatus is mechanically attached to the furnace open/close system, to ensure that the cleaning brush will not collide with the hot crucible.
The cleaning brush will never burn !
Reasonable engineering of the cleaning mechanism rules out any possibility of the cleaning brush to catch fire.
To confirm this fact, ELTRA offers free replacement of each burned cleaning brush, during the entire working life of the analyzer.

– After each analysis start, a thyristor switches on the high voltage transformer with a “soft-start” to prevent any current surge in the main power supply and therefore eliminating the risk of blowing fuses.
– The induction coil is cooled internally with compressed air. The outside of the coil tube is cooled by the blower, which also ventilates the generator.
– The induction furnace uses standard ceramic crucibles, which are 1“ or 25 mm in diameter.

8 Miscellaneous

8.1 Ordering numbers

8.1.1 Chopper motor

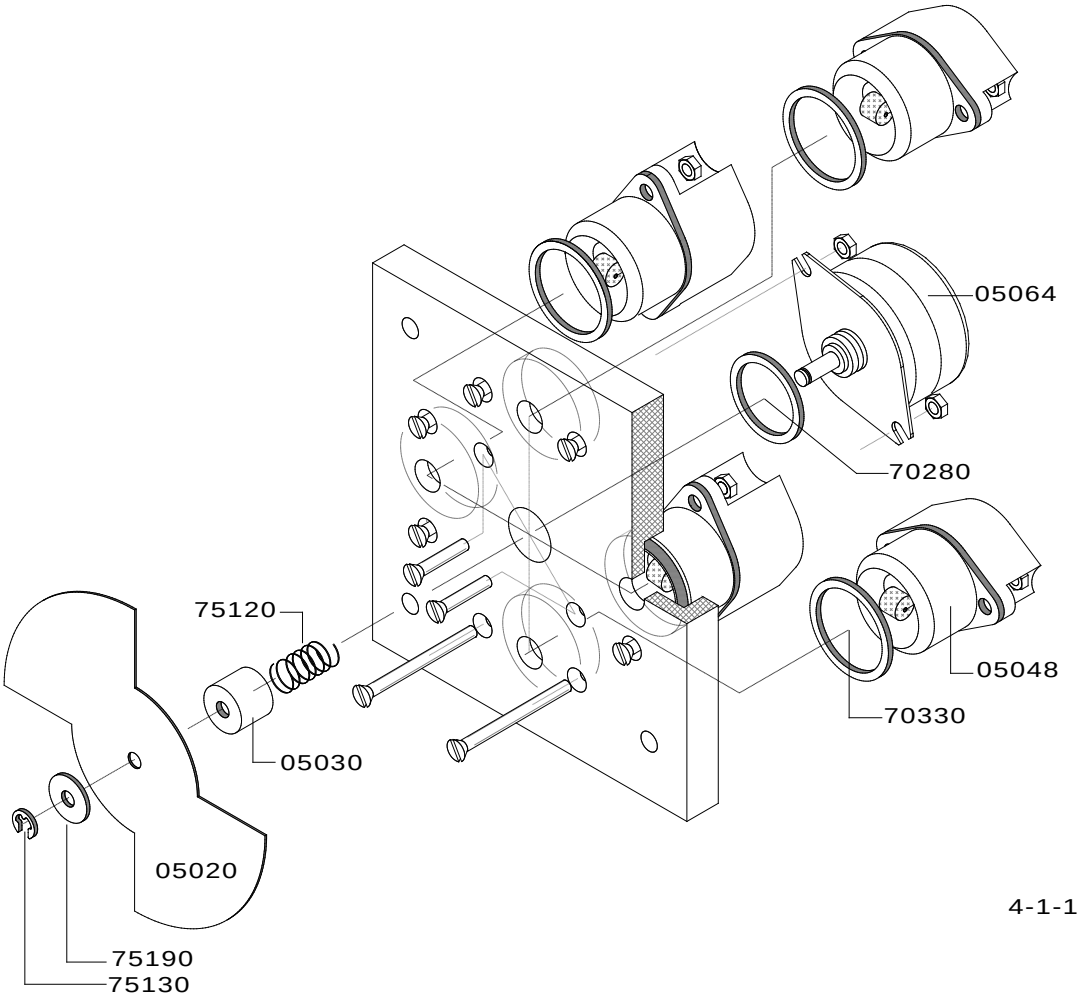
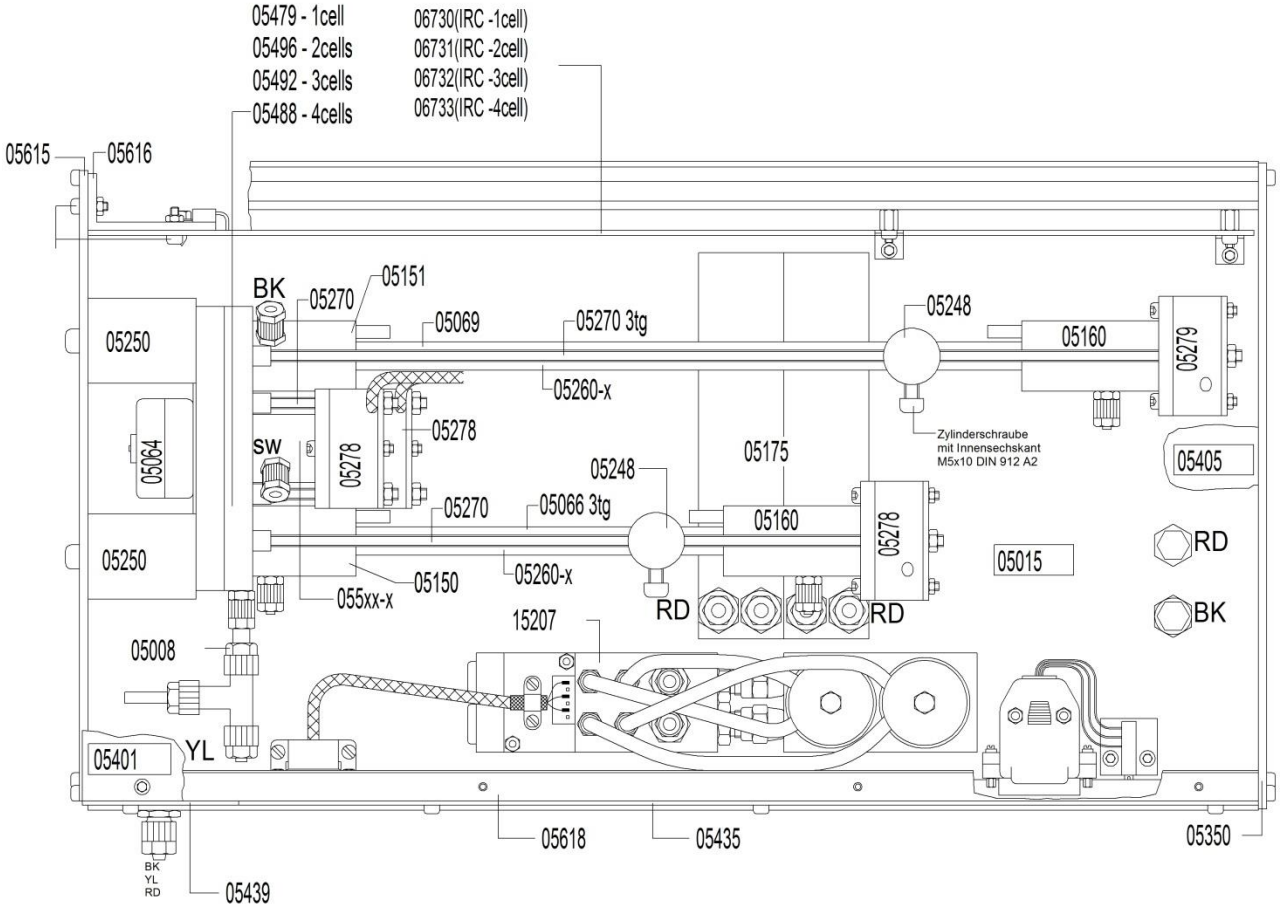


Fig. 37: 4-1-1

05020	Chopper blade
05030	Chopper blade holder
05064	Chopper motor
05048	Infrared source (emitter)
70280	O-ring
70330	O-ring
75120	Spring
75130	Retaining washer
75190	Washer

8.1.2 Infrared cells



05060	Reflector
05067	IR-path for high carbon
05150	IR-path connector with window source side
05160	IR-path connector with window detector side
05170	Gas conditioner
05244	IR 4 chopper
05260	IR-path tube (advice the length)
05270	Threaded rod (advice the length)
05275	Infrared preamplifier
06210	IR-cable
06670	IR-zero adjustment board
06733	Infrared electronics board
15207	Gas flow sensor
70180	O-ring
70330	O-ring
77510	Heaters for IR-cell

8.1.3 Front side

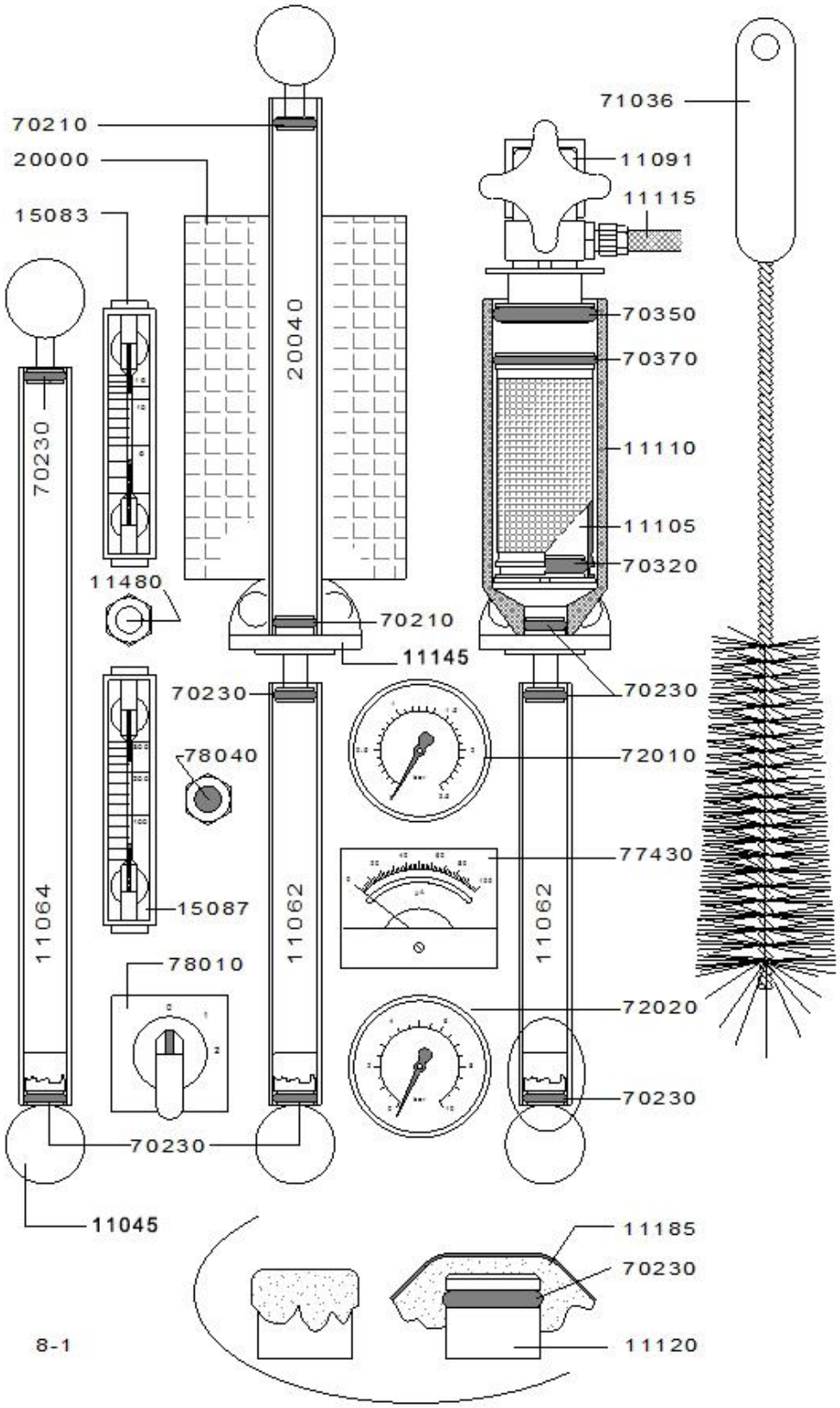


Fig. 38: Front side

05000	IR-cell
11180	Dust cartridge
11390	Oxygen solenoid valve
11400	Pressure outlet solenoid valve
11415	Oxygen stop solenoid valve
11430	Purge solenoid valve
11440	Bypass solenoid valve
11492	Pressure regulator
11492	Inlet pressure regulator
11495	Purge pressure regulator
12016	Gas flow and furnace control board HF 42
12044	Transformer
16100	Power supply board NK 31
18467	Microcontroller board UNI

8.1.4 Right side:

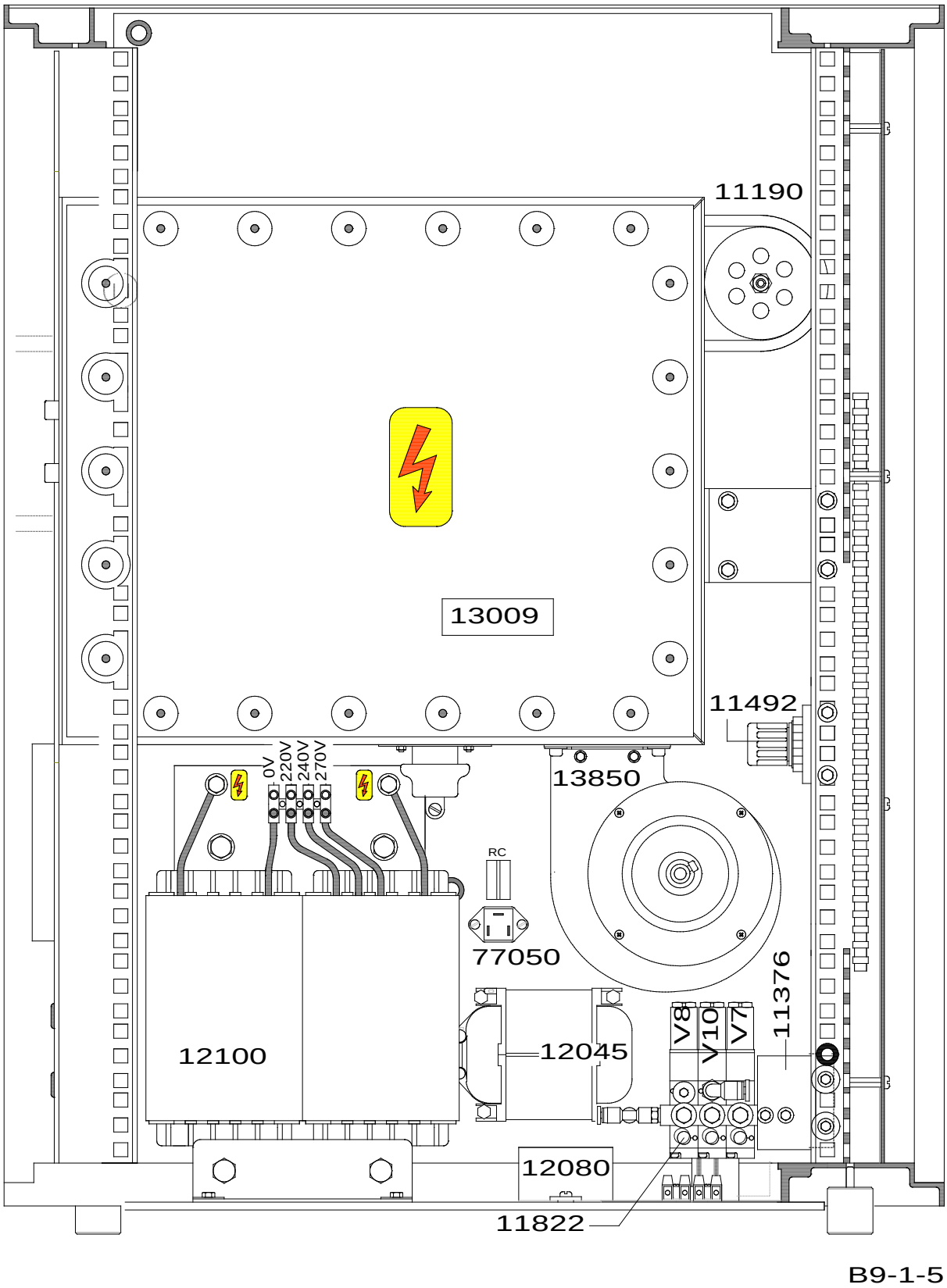


Fig. 39: Right side

11190	Exhaust muffler
13850	Centrifugal blower
11376	Fixing plate for 11822
77050	TRIAC
11492	Pressure regulator
77135	Capacitor
11822	Pnematic valve block
12045	Transformer
12080	Rectifier
12100	Transformer

8.1.5 Pneumatics

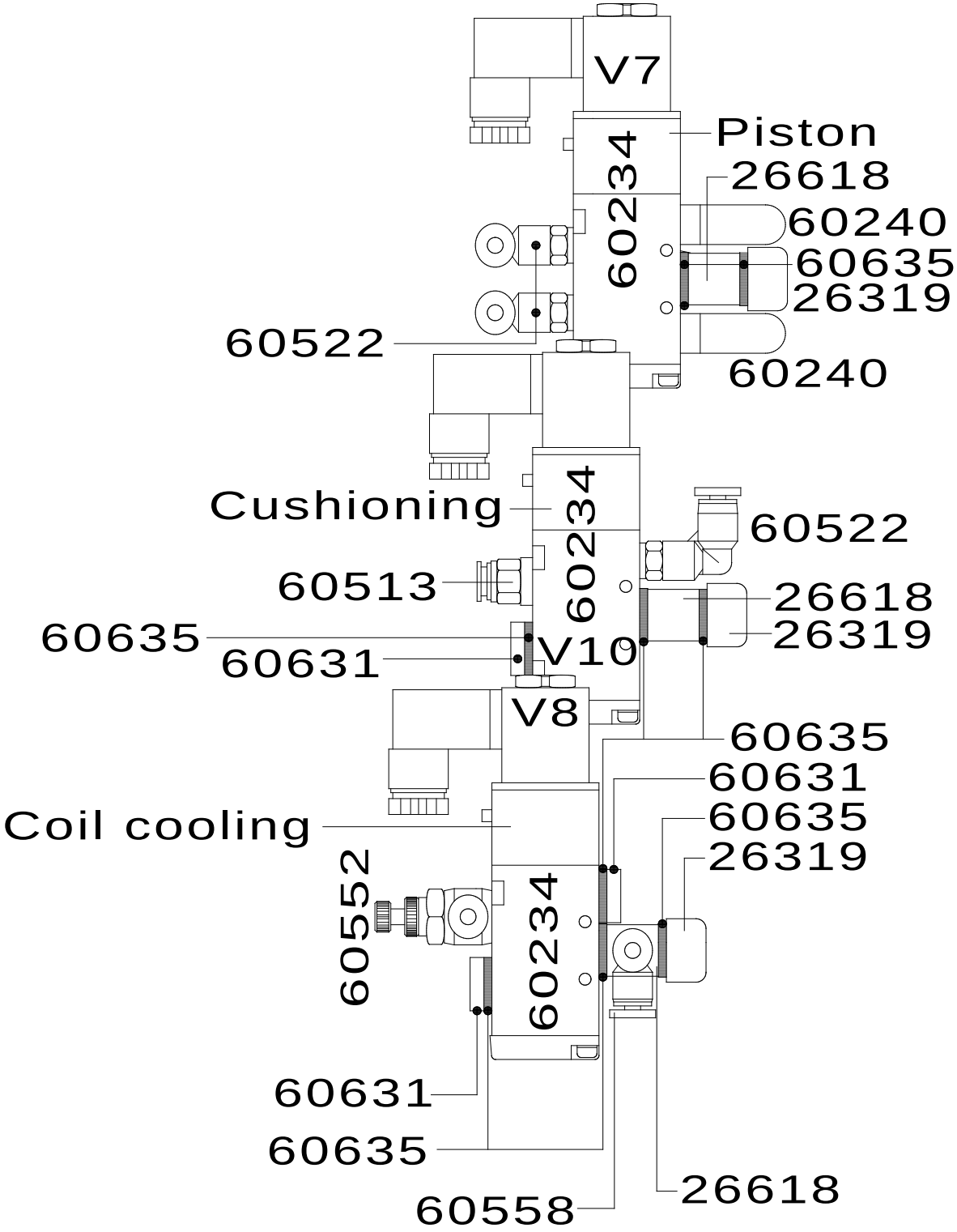


Fig. 40: Pneumatics

26319	Hollow screw
26618	Valve block
60234	Pneumatic valve
60240	Silencer
60513	Fiting
60522	Fiting
60631	Closure
60635	Seal

8.1.6 Oscillating circuit

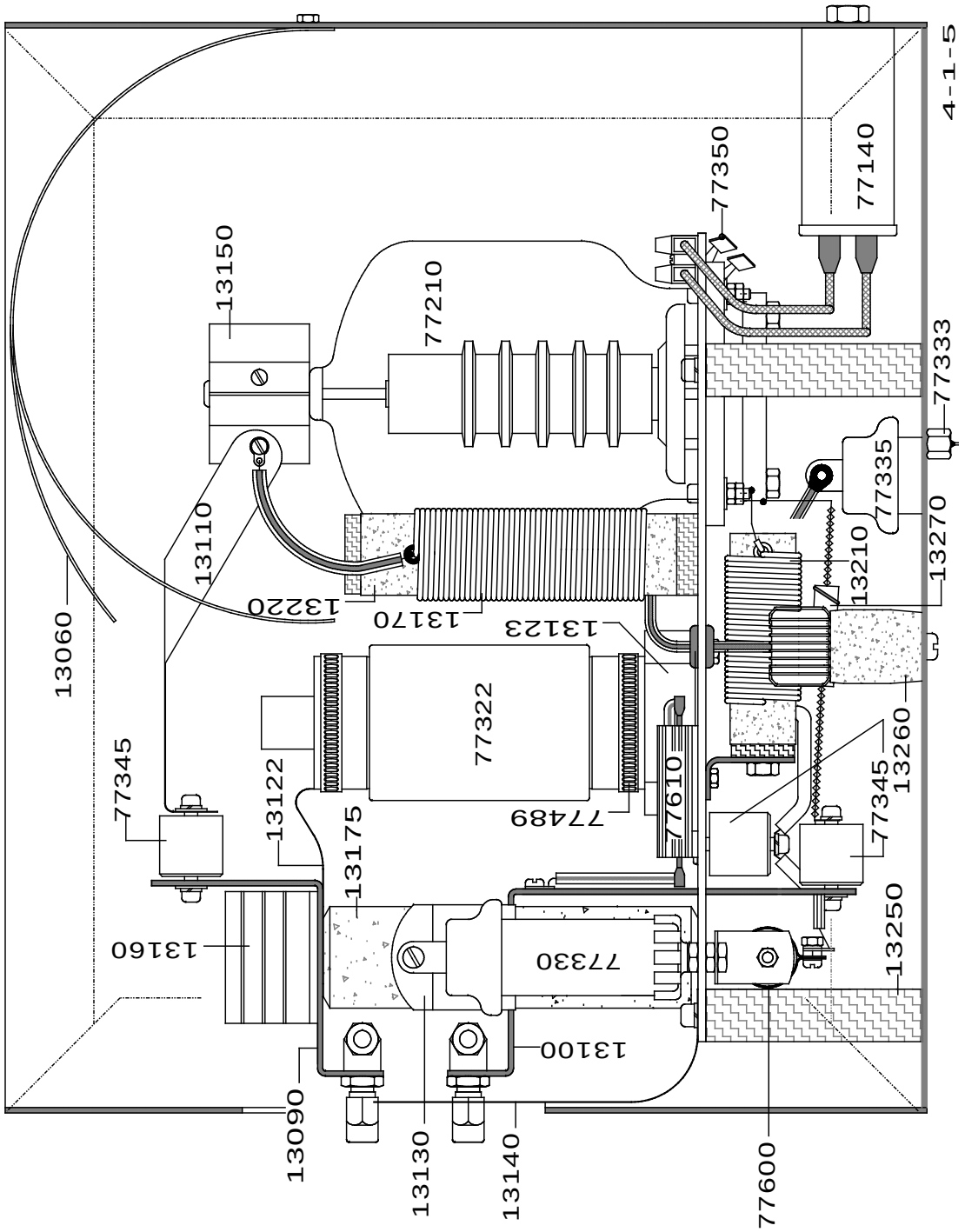


Fig. 41: Oscillating circuit

13060	Protection sheet
13081	Capacitor support
13090	Upper coil connector
13100	Lower coil connector
13110	Anode connector
13122	Capacitor connector
13130	Capacitor connector
13140	Ground connector
13150	Anode heat sink

13160	Coil heat sink
13170	Radiation shield
13175	Insulator
13210	Grid choke
13220	Anode choke
13250	Chassis support
13260	High voltage filter
13270	Resistor
77140	HF-filter
77210	Oscillator tube
77322	Capacitorr
77330	Capacitor
77335	Capacitor
77333	Filter
77345	(13261; 13262; 77340; 77341; 77342) Capacitor
77350	Capacitor 100 nF
77489	Bracket
77600	Resistor
77610	Resistor

8.1.7 Furnace

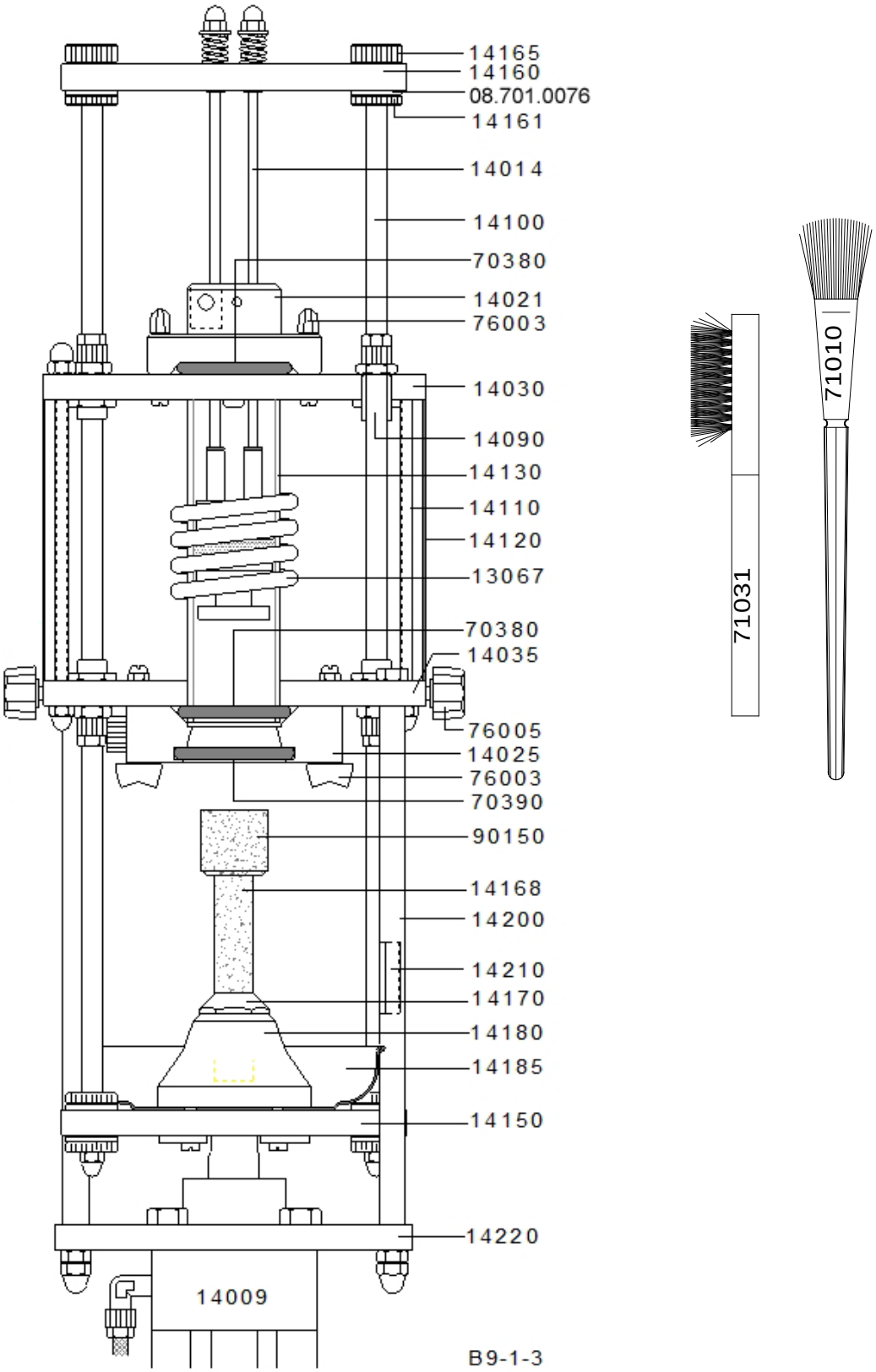
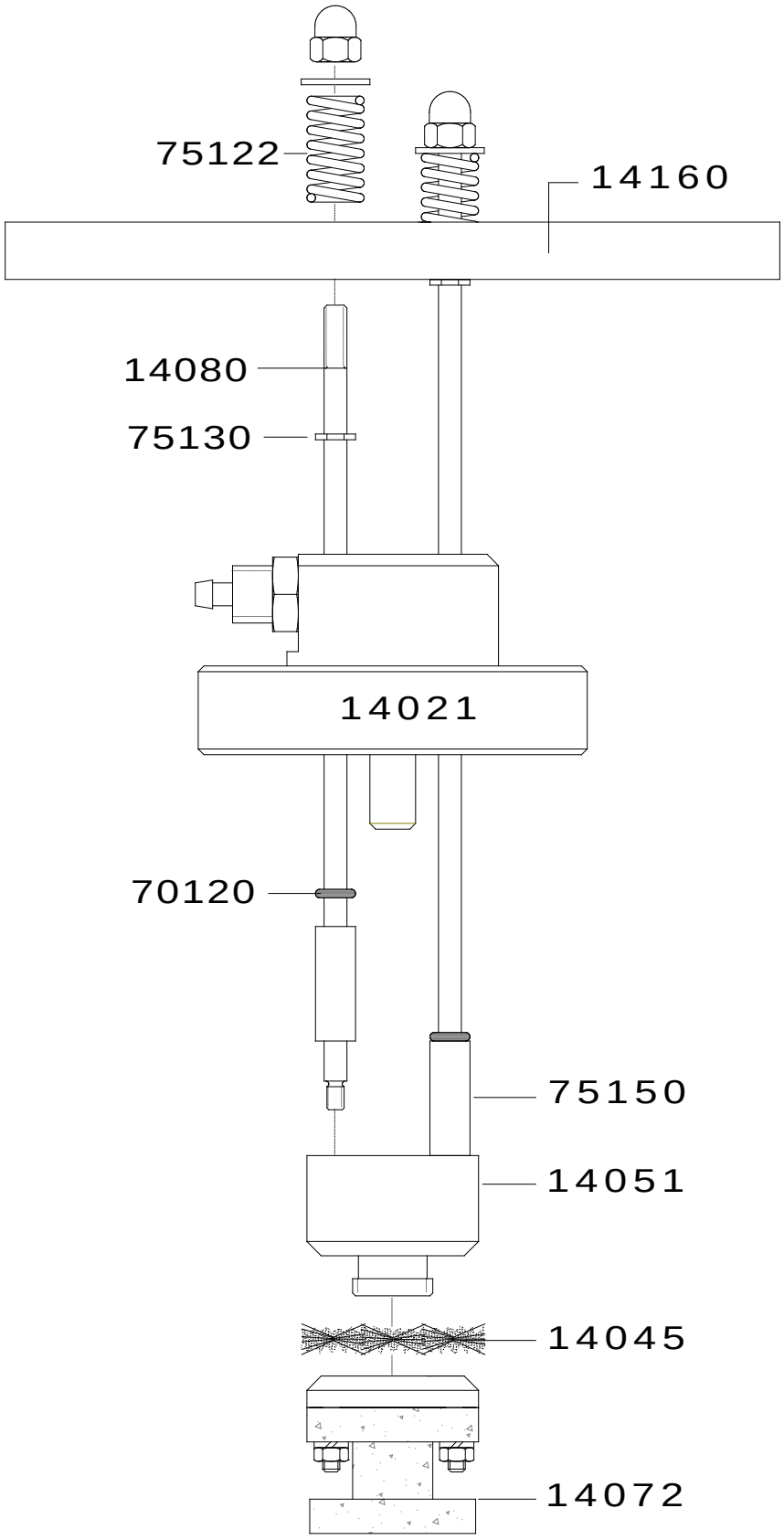


Fig. 42: Furnace

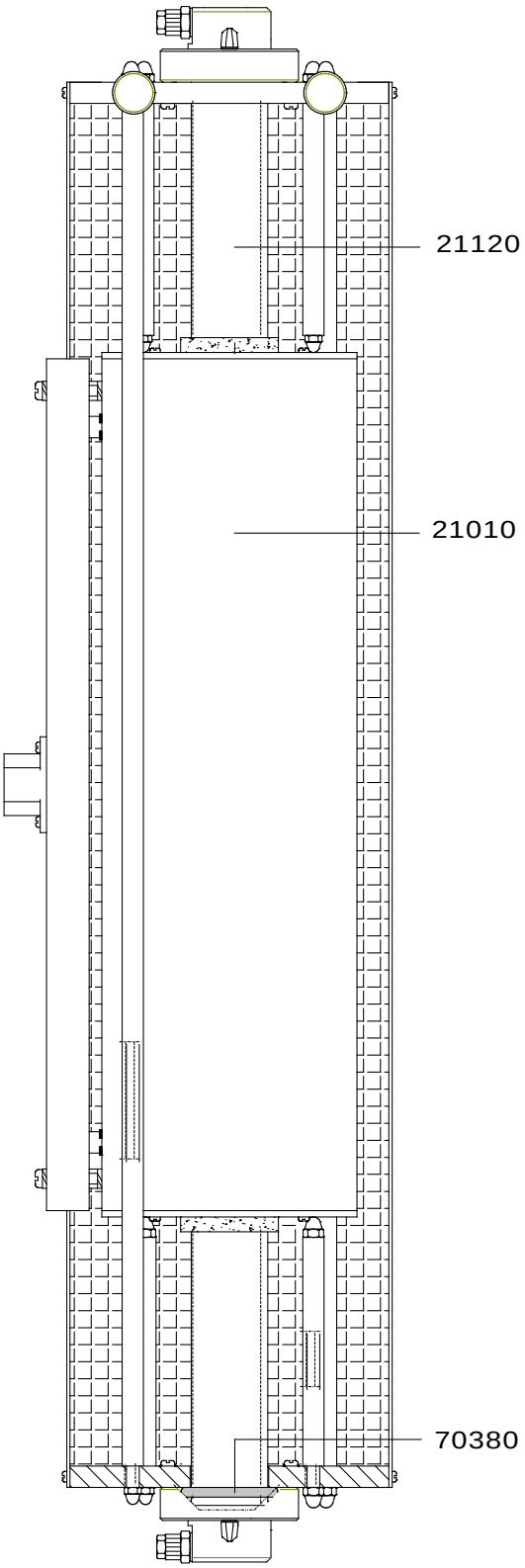
13067	Combustion coil
14009	Pneumatic cylinder for furnace lift
14021	Upper furnace lock
14026	Lower furnace lock
14030	Upper furnace plate
14035	Lower furnace plate
14090	Bearing
14100	Mounting rod
14110	Threaded rod
14120	Furnace cover
14130	Combustion tube
14150	Lower log
14160	Upper log
14161	Lower knurled nut
14165	Upper knurled nut
14168	Pedestal
14170	Pedestal mount
14180	Furnace closure
14185	Tray
14200	Metal tube
14210	Threaded rod
14220	Cylinder support
70380	O-ring
70390	O-ring
71010	Cleaning brush for pedestal
71031	Cleaning brush for radiation shield
76003	Wing nut
76005	Knurled nut
90150	Crucibles
08.701.0076	Washer

8.1.8 Furnace cleaning mechanism



14014	Complete furnace cleaning assembly unit:
14021	Upper furnace lock
14045	Cleaning brush for combustion tube
14051	Brush holder
14072	Ceramic heat shield for brush
14080	Cleaning mechanism Rod
14160	Upper log
70120	O-ring
75122	Spring
75130	Safety spring
75150	Metal tube

8.1.9 Gas purification furnace, optional



21010	Heather section
21120	Quartz tube
70380	O-Ring

8.2 Packing

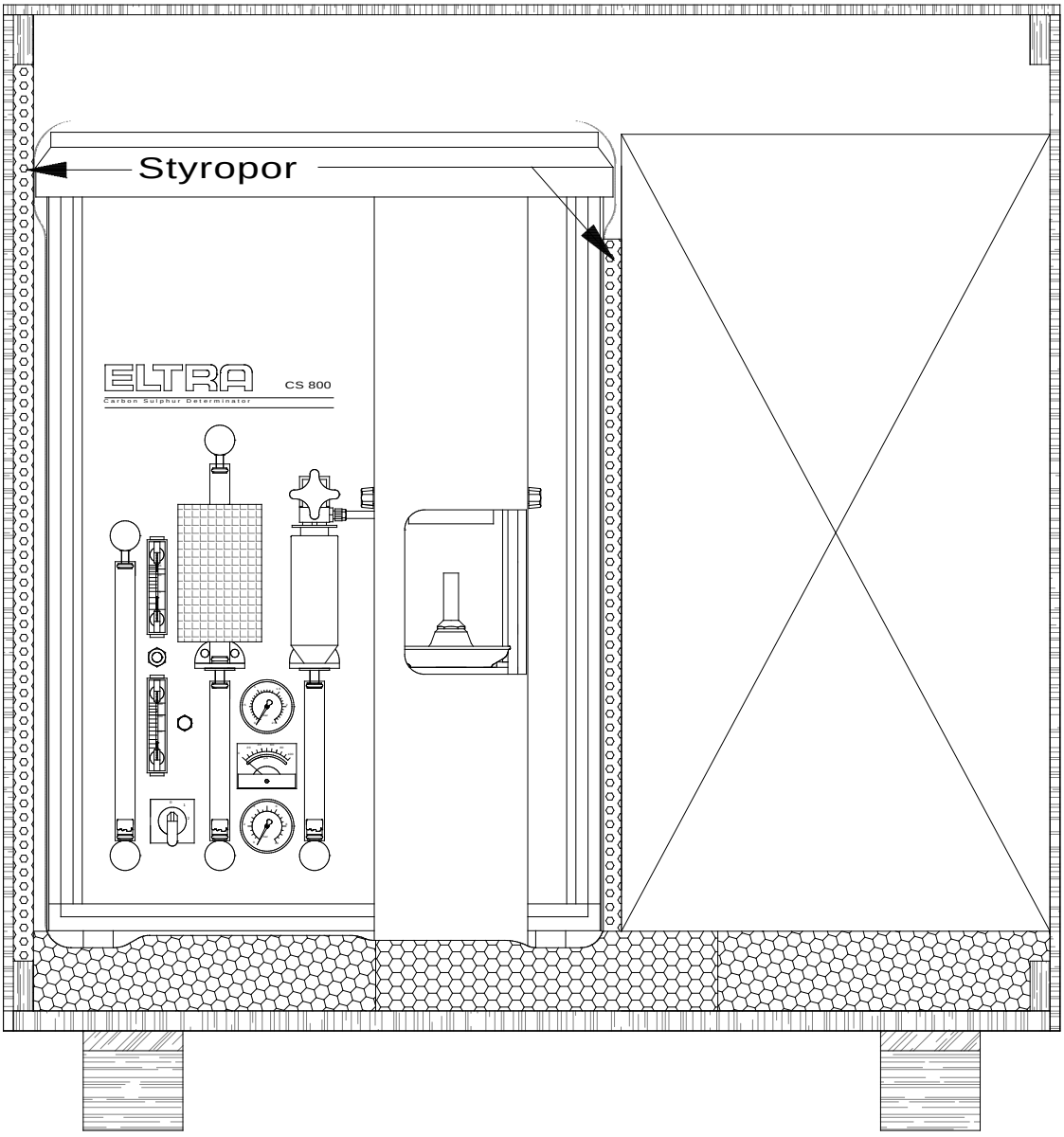


Fig. 43: Packing

Before packing, the analyzer and furnace must be wrapped in plastic foil, to protect it from moisture and dust, and then to be placed in a wooden case. The wrapped analyzer should be surrounded by a layer of foam (chips) of at least 10cm, in order to avoid any damage due through transportation.

Especially the foam where the analyzer is placed on, is very important. It should neither be too hard nor too soft. When the foam is too soft, the analyzer will practically touch the wood. Fix the foam on the bottom of the wooden case by gluing.

The analyzer and the furnace should be wrapped in plastic foil, especially when you use chips or any other kind of material in small pieces. The glass tubes must be empty.

In case of transportation by vessel, use a seaworthy crate.

Packing is done as follows:

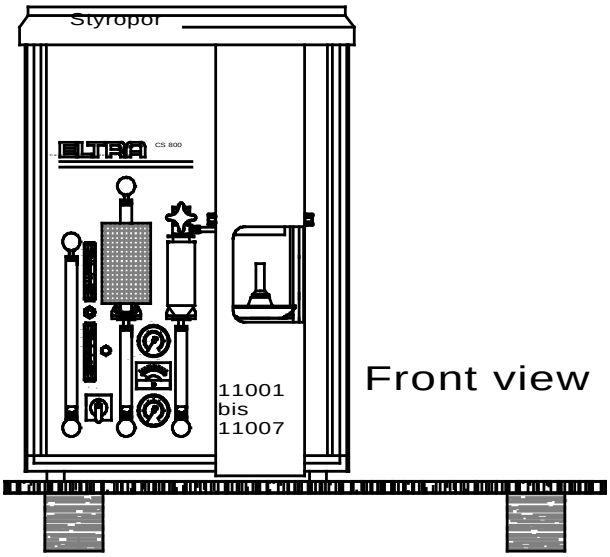


Fig. 44: Packing-Front view

- Place the analyzer directly on the pallet with the right side towards the middle of the pallet, because the furnace and the transformer are the heaviest parts of the analyzer.

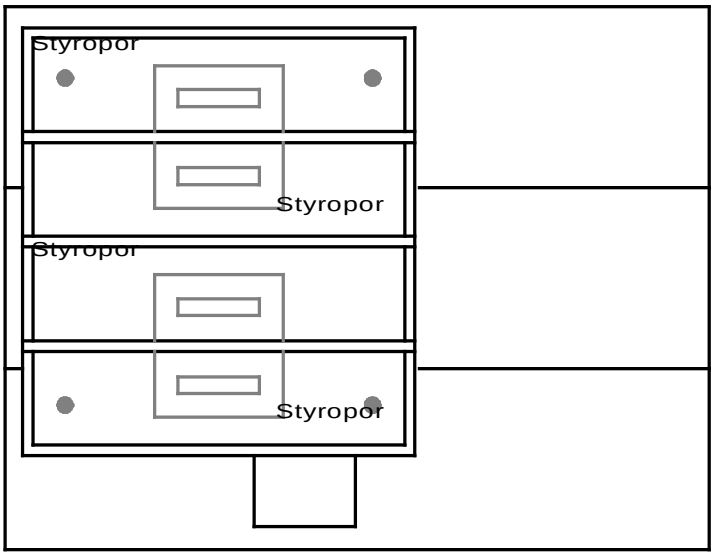


Fig. 45: Packing-Top view

- Shift the analyzer to the exactly required position.

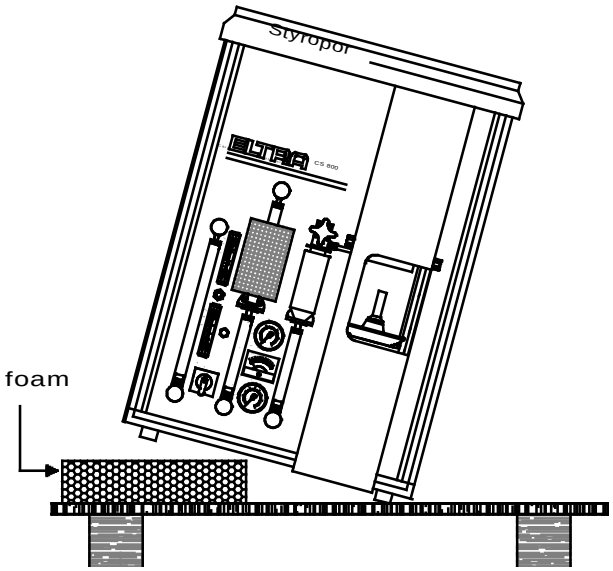


Fig. 46: Packing-Foam I

- Tilt the analyzer to the furnace side and place a piece of foam at the right position.

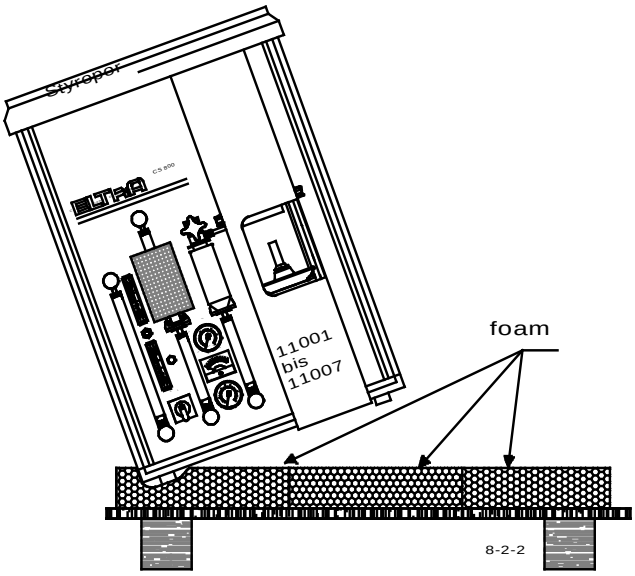


Fig. 47: Packing-Foam II

- Tilt the analyzer to the other side and place the second piece of foam at the right place. If necessary, a third piece of plastic foam can be placed on to the pallet.

8.3 Pre-installation guide

W5.0021

WARNING

Fire hazard / Risk of burns

Hot parts (crucibles, reagents,...) can fall down

- Ignition of tables, floors, or any other surface the hot part falls on
- Ignition of clothes and any other material

- **Set up the analyser in a flame retardant environment. Pay special attention to the table, the floor and any other surface being in the near of the analyzer**
- **Always wear suitable clothing**

- **Keep the work environment clear of all materials that could catch fire**

Following requirements apply, when installing the analyzer:

Carrier gas	Oxygen 99.5% pure; 2 - 4bar (30 - 60psi)
Compressed air	4 – 6bar (60 - 90psi)
Mains power supply	230VAC ±10%, 50/60Hz; 16A fuse

Analyzer dimension	560 x 780 x 600mm
Analyzer weight	approx. 110kg

– It is important to install the instrument on a stable place.
– The balance should rest on a vibration free support.

Gas connections:

The supplied tubes carry a connector with G¼" inner diameter ".

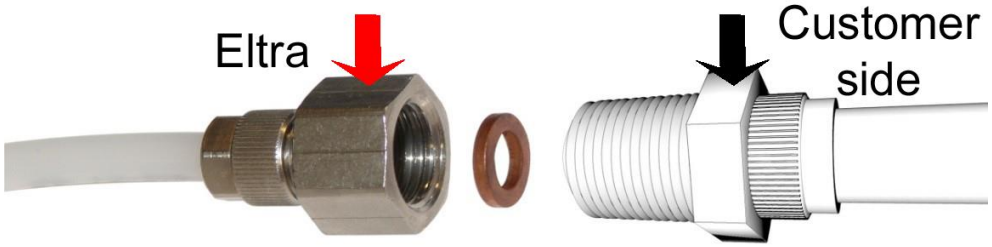


Fig. 48: Carrier gas tube

Connections for compressed air:

The tubes supplied together with the analyzer, carry a connector with G¼" inner diameter.

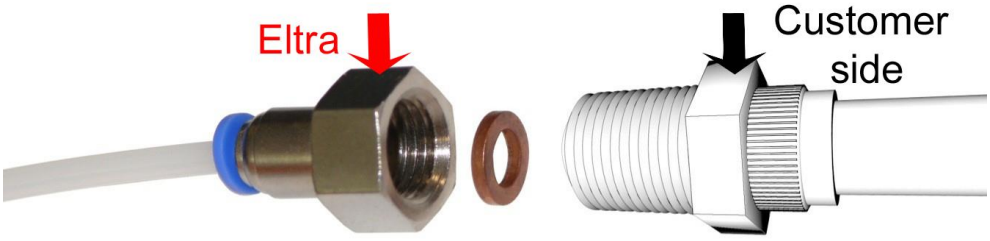


Fig. 49: Compressed air tube

9 Approved methodologies to which Eltra instruments conform

9.1 Inorganic materials (Metals)

Norm	Elements	Materials	Instruments
DIN EN ISO 9556:2002-04	C	Steel and Iron	CS-800 CS-2000
ISO 4935:1989 DIN EN 24935:1992-07	S	Steel and Iron	CS-800 CS-2000
ASTM E 1019:2011	C, N, O, S	Steel, Iron, Nickel / Cobalt Alloys	CS-800 CS-2000 ON-900 OH-900 ONH-2000
ASTM E 1587:2010	C, N, O, S	Refined Nickel	CS-800 CS-2000 ON-900 OH-900 ONH-2000
ASTM E 1409:2013	N, O	Titanium and Titanium Alloys	ON-900 OH-900 ONH-2000
ASTM E 1569:2009	O	Tantalum	ON-900 OH-900 ONH-2000
ASTM E 1447:2009	H	Titanium and Titanium Alloys	OH-900 ONH-2000
ASTM E1915 - 13	C, S	Metal Bearing Ores and Related Materials (i.e. tailings, waste rock)	CS-580 CS-800 CS-2000
UOP703 - 09	C	Catalysts	CS-800 CS-2000
ASTM E 1941:2010	C	Refractory and Reactive Metals	CS-800 CS-2000
ASTM E2575 - 08	O	Copper	ONH
DIN EN ISO 15351	N	Steel	ONH 2000 ON900
ISO 22963	O	Titan	ONH serie
ISO 17053	O	Steel/Iron	ONH serie
DIN EN ISO 15349-2	C	Steel	CS 800 CS 2000
ISO 13902	S	Steel/Iron	CS 800

			CS 2000
ISO 4689-3	S	Iron ore	CS 800 CS 2000
ISO 7524	C	Nickel	CS 800 CS 2000
DIN EN 27526	S	Nickel	CS 800 CS 2000
DIN EN ISO 15350	C, S	Steel / Iron	CS 800 CS 2000
DIN EN ISO 3690	H	Steel	H 500
DIN EN ISO 10720	N	Steel	ON 900 ONH 2000
ISO 10719	C	Steel	CS 800 CS 2000

9.2 Organic materials (Oil, Coal, foodstuffs)

Norm	Elements	Materials	Instruments
ASTM D 1552:2008	S	Oil and Petrolium Products	CS-580 CS-2000
ASTM D 4239:2013;	S	Coal and Coke	CS-580 CS-2000
ASTM D 5016:2008	S	Coal and Coke Ash	CS-580 CS-2000
ASTM D 1619:2011	S	Carbon Black	CS-580 CS-2000
DIN EN 13137:2001-12	C	Waste	CS-580 CS-2000
DIN ISO 10694:1996-08	C	Soil samples	CS-580 CS-2000
ASTM D 7348:2013	Loss On Ignition (LOI)	Combustion Residues	TGA Auto TGA Thermo Chain
ISO 15178	S	Soil	CS 580 CS 800 CS 2000

10 Disposal

NOTICE

N5.0079

Disposal of the Elementrac packaging
Please refer to your country's packaging disposal guidelines and, if applicable, your company's packaging guidelines.

Please observe the respective statutory requirements with respect to disposal.
Information on disposal of electrical and electronic machines in the European Community.
Within the European Community the disposal of electrically operated devices is regulated by national provisions that are based on the EU Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE).
Accordingly, all machines supplied after 13.08.2005 in the business-to-business area to which this product is classified, may no longer be disposed of with municipal or household waste. To document this they have the following label:

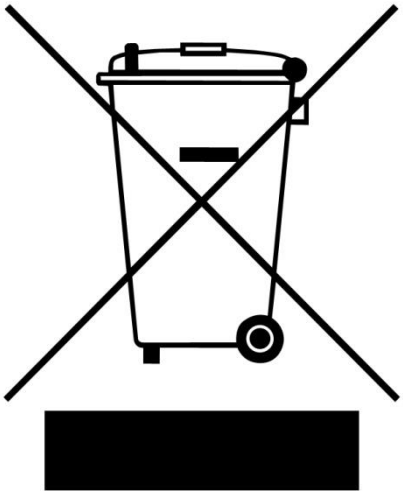


Fig. 50: Disposal label
Since the disposal regulations within the EU may differ from country to country we would request you to consult your supplier.

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ELTRA
ELEMENTAL ANALYSERS

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