OHIO LUMEX CO., INC.

PYRO-915+ ATTACHMENT

For Mercury Analyzer RA-915M

OPERATION MANUAL

951-07-00-00-00 OM

TWINSBURG, OH

2013

Read the instructions in this manual carefully before operating the PYRO-915+ Attachment. Neither OHIO LUMEX CO., INC. nor its representatives will accept any liability for damage caused by non-observance of the requirements of this manual.

PYRO-915+ Attachment is subject to improvements and the information in this manual may not include the latest updates on the PYRO-915+ Attachment design.

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About this manual

This manual is designed to familiarize you with the principle of operation and structure of the PYRO-915+ attachment (hereinafter referred to as the attachment), its design, performance characteristics and operating conditions. It contains information that will provide proper operation and comprehensive utilization of the attachment's capabilities. Please take time to read the manual in order to attain the best results in operation.

Prior to studying this manual, you have to be acquainted with the RA-915M Mercury Analyzer Operation Manual and Software RAPID User's Manual.

This manual contains:

- List of important safety measures, warnings and precautions, which you should follow when operating with the attachment;
- Description of the attachment, its basic performance and analytical characteristics and operating conditions;
- Brief description of the physical foundations and principle of operation of the attachment and of its structure;
- Functional controls of the attachment, their purpose and operation;
- Procedures for preparation of the attachment for operation together with the RA-915M Mercury Analyzer;
- List of main procedures for the attachment maintenance;
- Instructions for troubleshooting and removal.

Symbols used in this manual

Danger:

Used when failure to observe a safety precaution may result in a serious injury.

Caution:

Used when there is a danger of a minor damage to the attachment if you do no follow the precautions.

Used to indicate supplementary information or to call your attention to recommendations which may simplify daily operation.

Safety guidelines

Important safety precautions

Read these guidelines completely before starting operation with the attachment.

- Carefully study all the sections of this operation manual, the attachment design, and operational procedures;
- Connect the attachment to the RA-915M Mercury Analyzer properly;
- Do not turn on heaters of the thermal chamber unit unless the carrier gas (air) pumping through the thermal chamber is provided;
- External surfaces of the thermal chamber unit and external optical unit can remain heated up to 60…80°C after the attachment has been switched off. To avoid skin burn do not touch the surfaces until the thermal chamber fully cools;
- Turn off the power supply and pumping unit after measurements only after cooling of the thermal chamber by built-in fans during 10-15 min in **Standby** mode;
- Do not touch cases and other metal elements of the back side of the heated thermal chamber unit;
- Do not remount the thermal chamber unit from the external optical unit before it completely cools;

Danger:

The thermal chamber unit cooling time is 30 min.

- Do not allow ingress of liquids on the case or inside the power supply and pumping unit;
- Check the connection of silicone tubes to the inlet gas fitting of the thermal chamber unit and the outlet air fitting of the power supply and pumping unit before switching on the attachment;
- Do not leave the sample port of the thermal chamber unit opened;
- Do not try to repair the attachment yourself.

- Call an authorized agent or certified service engineer in the following cases:
  - ✓ If the attachment does not operate properly;
  - ✓ If the attachment has fallen down;
  - ✓ If a liquid has got inside units.
- Observe the national legislation stating safety regulations for operation in chemical laboratories and safety rules for operation with electric appliances. Follow instructions laid down in this Manual as well as the safety requirements and the instructions given in the RA-915M Mercury Analyzer Operation Manual.
- Personnel admitted to operate the device are recommended to undergo training at the Manufacturer and/or Supplier premises or at a regional service centre.

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1 Introduction

1.1 General description

The PYRO-915+ attachment is designed for converting all mercury species in analyzed sample into elemental mercury using thermal decomposition with subsequent transportation of released mercury vapour to the analytical cell of the attachment.

The RA-915M Mercury Analyzer equipped with the PYRO-915+ attachment and a personal computer (hereinafter referred to as analytical complex) is designed for the direct determination of total mercury content in solid and liquid samples for environmental monitoring, technological process control, industrial sanitary inspection and scientific research. The direct determination means that analysis is performed without preliminary sample preparation (acid digestion, etc.).

1.2 Performance characteristics and specifications

Power supply	AC 100-240 V 50/60 Hz
Power consumption, W, max	700
Continuous operation time, h	8
Dimensions of the power supply and pumping unit (LxWxH), mm, max	400x280x135
Dimensions of the thermal chamber unit assembled with the external optical unit (LxWxH), mm, max	430x340x135
Mass, kg, max	17.5
Air flow rate, dm^3/min	1.0...3.0
Sample mass, mg	10...500

1.3 Operating conditions

Ambient air temperature, °C	10 … 35
Atmospheric pressure, kPa	84.0 … 106.7
Relative humidity at 25℃ , %, max	80
Mercury concentration in ambient air, ng/m^3, max	100

1.4 Attachment components

The complete delivery set of the attachment is given in Table 1-1.

Table 1-1

№	Item	Quan-tity, pcs	Catalogue code
1	Thermal chamber unit	1	5-054-004
2	External optical unit	1	5-054-006
3	Pumping unit	1	5-054-003
4	Quartz window, diameter 38 mm	2	5-054-014
5	Mount for quartz window	2	5-054-010
6	Outlet absorption filter	2	5-054-008
7	Set of silicone tubes	1	5-054-024
8	Gas tee 10 mm	1	5-054-023
9	Power cord	1	5-014-033
10	Quartz boat with holder	5	5-054-011
	Spares kit		
11	Quartz window, diameter 38 mm	4	5-054-014
12	Power fuse 8A	2	5-054-017
13	Quartz boat	5	5-054-012
14	Inlet charcoal absorption filter	1	5-054-007
15	Wrench for mounting external optical unit to the mercury analyzer RA-915+*	1	5-044-009

№	Item	Quan-tity, pcs	Catalogue code
16	Wrench for mounting external optical unit to the mercury analyzer RA-915M	1	5-044-007
17	Sealing ring	5	5-054-013
	Documentation		
18	Operation Manual	1	5-053-003
19	Certificate of Quality	1	5-053-001
* Use when connecting to the RA-915+ Mercury Analyzer.			

1.5 Attachment design and principle of operation

The principle of operation of the PYRO-915+ attachment is based on the conversion of the bound mercury into elemental state using pyrolysis followed by the subsequent transport of the elemental mercury from the atomizer to the analytical cell by carrier gas (air).

The design scheme of the attachment is shown in Fig.1-1.

When selecting any operation mode using the display (5) of the power supply and pumping unit (6), the air pump (2) turns on. The air passes through the inlet charcoal absorption filter (1) with the aim to remove mercury vapour and to provide constant source of “zero air” as a carrier gas. Air flow rate is automatically maintained by the pumping system controller (4) with the flow meter (3).

Sample is placed into the sample boat (8) which is inserted into the first chamber of the atomizer (9) heated up to 200 – 800℃ (according to the selected operation mode, see Table A-1 in Annex A).

Mercury compounds evaporate and partially decompose forming elemental mercury. All gaseous products including mercury vapour are transported into the second chamber (10) of the atomizer by the carrier gas where mercury compounds are completely destroyed and the organic matrix of the sample is burnt out. Air flow from the atomizer enters the analytical cell (11) mounted on the external optical unit (12) and then passes through the outlet absorption filter (13) to exhaust ventilation. Detection of

mercury atoms takes place in the analytical cell (11) heated up to 610 - 730℃ and linked to the optical system of the mercu ry analyser via external optical unit (12).

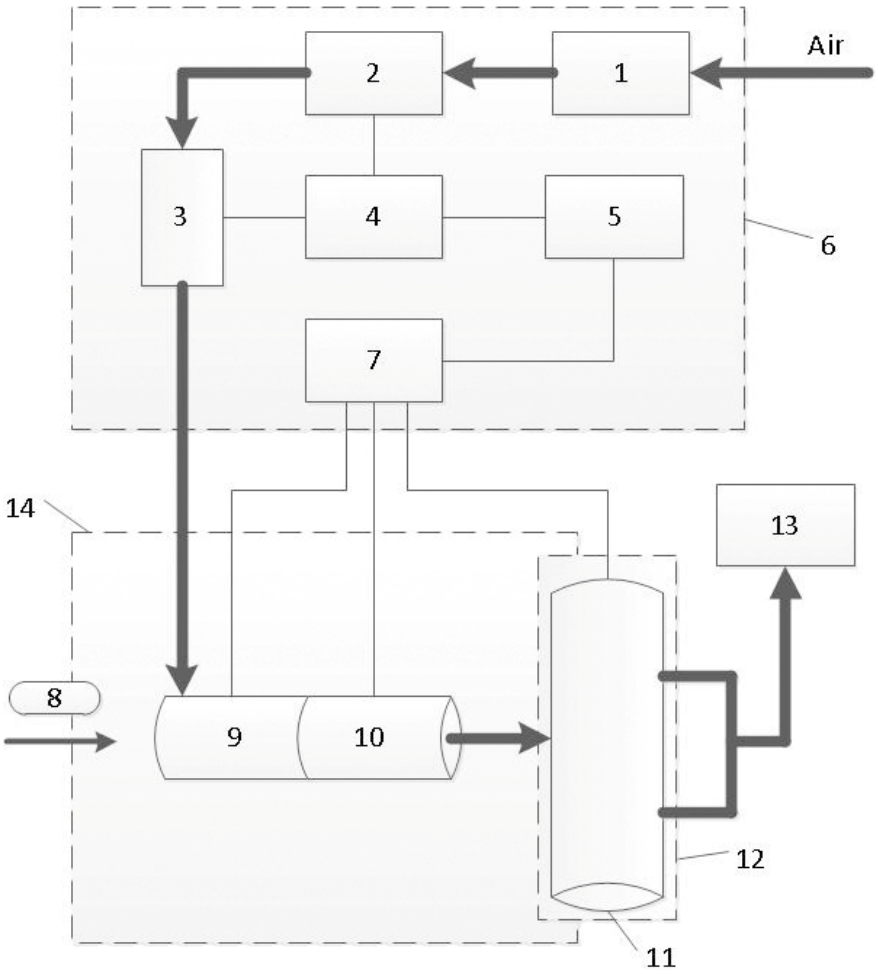

Fig.1-1 - Design scheme of the PYRO-915+ attachment

1 – Inlet charcoal absorption filter;
2 – Air pump;
3 – Flow meter;
4 – Pumping system controller;
5 – Display;
6 – Power supply and pumping unit;
7 – Power system controller;
8 – Quartz boat with holder;
9 – First chamber of the atomizer (evaporator);
10 – Second chamber of the atomizer (afterburner);
11 – Analytical cell (heated);
12 – External optical unit;
13 – Outlet absorption filter;

14 – Thermal chamber unit.

The main parts and components of the PYRO-915+ attachment are shown in Fig.1-2 (numbers of items correspond to these in Table 1-1).

Fig.1-2 - The main elements of PYRO-915+ attachment

Thermal chamber unit (Fig.1-2, item 1) is designed for heating of the sample to produce elemental mercury and transporting mercury vapour into the analytical cell. The main components of the thermal chamber unit are the atomizer and the analytical cell (heated).

External optical unit (Fig.1-2, item 2) is designed for linking of the analytical cell to the optical system of the analyser.

Power supply and pumping unit (Fig.1-2, item 3) is designed for management of temperature modes in the thermal chamber unit as well as for providing a preset air flow rate required for elemental mercury transportation into the analytical cell.

Quartz window (Fig.1-2, item 4) is transparent for the optical radiation thus letting the radiation pass through the analytical cell to the detector.

Mount for quartz window (Fig.1-2, item 5) is used for mounting of the quartz window to the analytical cell.

Outlet sorption filter (Fig.1-2, item 6) is intended for removal of mercury from the airflow after the analytical cell (i.e. cleans the exhaust gas from mercury to secure user's safety).

Set of silicone tubes (Fig.1-2, item 7). Silicone tube (diameter 4 mm, length 1 m) is used to connect the outlet air fitting of the power supply and pumping unit with the inlet gas fitting of the thermal chamber unit. Silicone tubes (diameter 10 mm) are used to connect the outlet gas fittings of the thermal chamber unit with the gas tee as well as to connect the gas tee with the outlet absorption filter.

Gas tee (Fig.1-2, item 8) is used to connect silicone tubes having 10 mm diameter.

Power cord (Fig.1-2, item 9) is used to connect the power supply and pumping unit to AC network.

Quartz boat with holder (Fig.1-2, item 10) is used for input of the analyzed sample into the atomizer.

1.6 Appearance and functional controls of main units of the attachment

1.6.1 General view of the analytical complex

The analytical complex comprising the RA-915M mercury analyzer, the attachment and the control PC is shown in Fig.1-3.

For detailed description of the RA-915M Mercury Analyzer, its functioning, performance characteristics and specifications refer to the Operation Manual of the analyser.

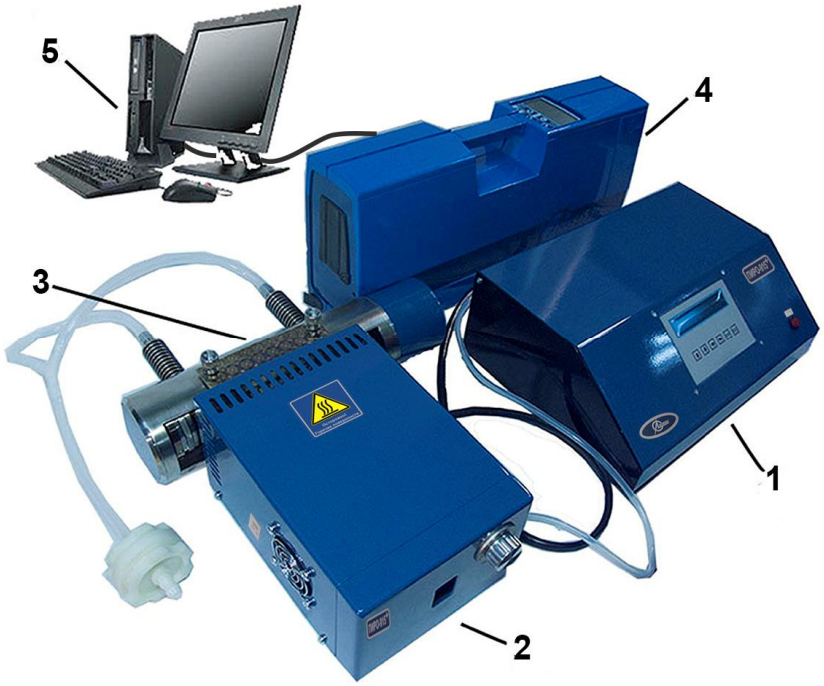

Fig.1-3 - The analytical complex (the RA-915M mercury analyzer with the attachment and the PC)

1 – Power supply and pumping unit,
2 – Thermal chamber unit,
3 – External optical unit,
4 – RA-915M mercury analyzer,
5 – PC.

1.6.2 Power supply and pumping unit

Front panel of the power supply and pumping unit is shown in Fig.1-4.

Rear panel of the power supply and pumping unit is shown in Fig.1-5.

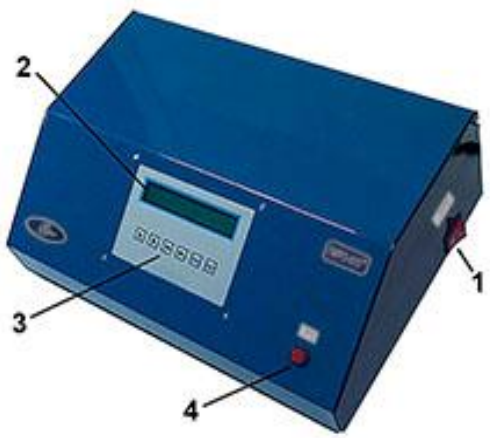

Fig.1-4 - Power supply and pumping unit (front side)

1 – **On/Off** switch;
2 – Display;
3 – Control buttons;
4 – **Boost heating** button.

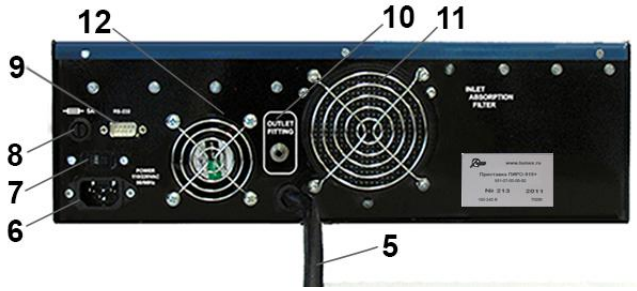

Fig.1-5 - Power supply and pumping unit (rear side)

5 – Outlet cord,
6 – Power cord socket,
7 – Voltage switch 115/230B,
8 – Fuse socket,
9 - RS232 port,
10 – Outlet air fitting,
11 – Inlet charcoal sorption filter,
12 – Cooling fan.

1.6.3 Thermal chamber unit

Overall view of the thermal chamber unit is shown in Fig.1-6.

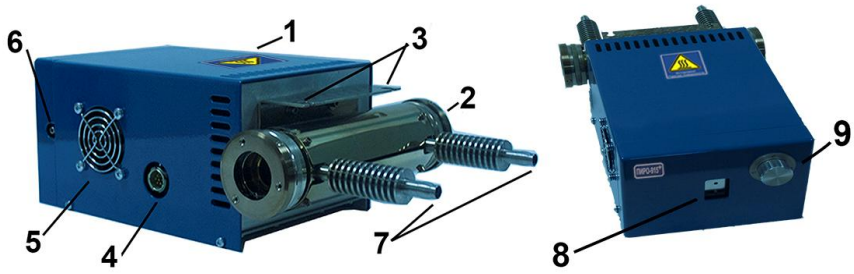

Fig.1-6 - Thermal chamber unit

1 – Atomizer;
2 – Analytical cell;
3 – Fastening elements;
4 – Cord socket;
5 – Cooler;
6 – Inlet gas fitting;
7 – Outlet gas fittings;
8 – Sample port for boat input;
9 – Sample port shutter handle.

1.6.4 External optical unit

Overall view of the external optical unit is shown in Fig.1-7.

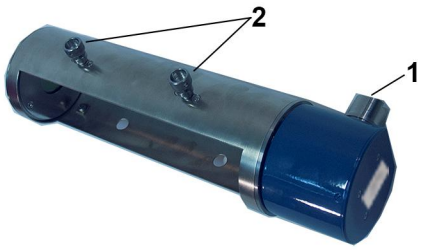

Fig.1-7 - External optical unit

1 – Sleeve fitting to the mercury analyzer;
2 – Thumb screws.

2 Attachment operation

2.1 Unpacking the attachment

Be careful while unpacking the attachment because some components can be easily damaged or broken and become unusable.

Make sure that the package with the attachment is stored indoors for at least ten hours after the transportation at temperatures below 0°C and then start unpacking the attachment.

Before starting operation with the attachment make sure that there are no external damages of the attachment and its accessories. Check if the delivery set is complete in accordance with the enclosed packing list.

Caution:

In case of inconsistencies please inform your Supplier or the LLC «Lumex-marketing» representative.

2.2 Analytical complex assembling

Prepare the RA-915M mercury analyzer for operation according to the RA-915M Mercury Analyzer Operation Manual (B0100-00-00-00-00 OM).

To assemble the analytical complex, proceed as follows:

1. Place the PC, the RA-915M mercury analyzer and all elements of the PYRO-915+ attachment on the workplace;

2. Mount the external optical unit to the port for its mounting on the right-hand side of the RA-915M mercury analyzer as shown in Fig.2-1.

Fig.2-1 - Mounting external optical unit on the RA-915M mercury analyzer

3. Secure it using the wrench for mounting of the external optical unit to the analyzer from the tool kit as shown in Fig.2-2.

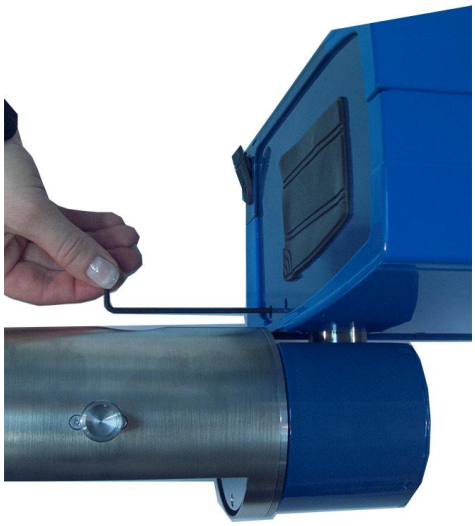

Fig.2-2 - Securing external optical unit on the mercury analyzer

4. Place the quartz windows into the mounts for quartz windows. Carefully attach them to the analytical cell, press slightly and firmly fix the mounts by clockwise rotation (see Fig.2-3).

Fig.2-3 - Mounting quartz windows to the analytical cell

5. Insert the thermal chamber unit so that the analytical cell appears in the external optical unit on its optical axis and fastening elements of the thermal chamber unit and the thumb screws of the external optical unit coincide (see Fig.2-4).

6. Secure the thermal chamber unit on the external optical unit with the thumb screws (see Fig.2-5).

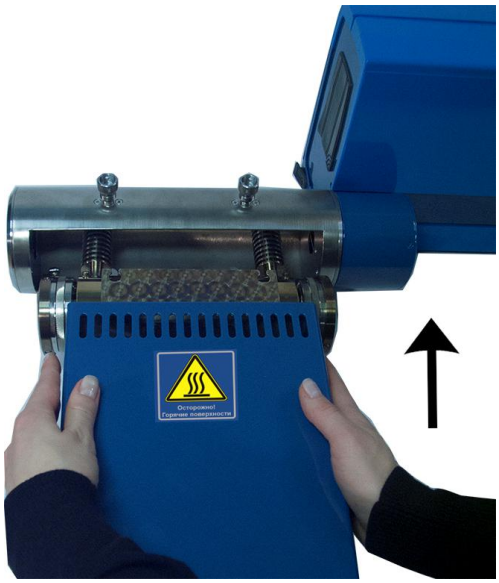

Fig.2-4 - Mounting the thermal chamber unit to the external optical unit

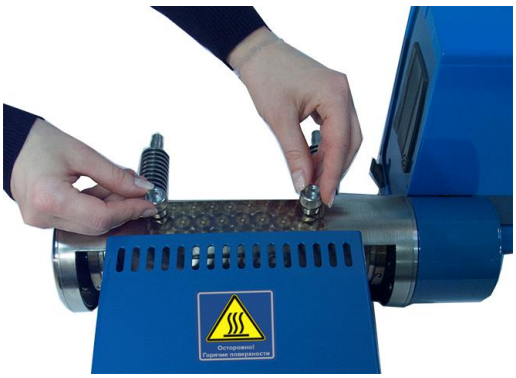

Fig.2-5 - Securing the thermal chamber unit on the external optical unit

7. Connect the inlet gas fitting of the thermal chamber unit to the outlet air fitting of the power supply and pumping unit using silicone tube with the diameter of 4 mm (Fig. 1-2, item 7). Connect the outlet gas fittings of the thermal chamber unit and the gas tee via two silicone tubes with the diameter of 10 mm. Connect the free end of the tee with the outlet sorption filter via the third silicone tube of the same diameter as shown in Fig.2-6. To abduct outlet gases into the exhaust ventilation (hood) connect the out-

let fitting of the sorption filter with any suitable tube and bring out the other end of the tube to the exhaust ventilation.

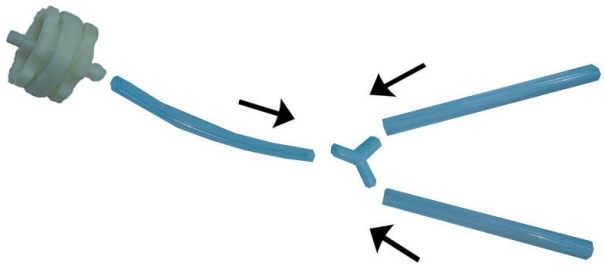

Fig.2-6 - Connecting of the silicone tubes with the gas tee

8. Connect the power cord (Fig.1-5, item 5) to the appropriate socket (Fig.1-6, item 4). Connect the power supply and pumping unit to an AC network using the power cord (Fig.1-2, item 9).

9. Connect the RA-915M mercury analyzer to the PC on which the RAPID Software is installed (for details, refer to the RA-915M Mercury Analyzer Operation Manual). The analytical complex should be assembled as shown in Fig.1-3.

10. Switch the RA-915M mercury analyzer and the PC and check the serviceability of the analyzer according to its manual.

2.3 Pre-operational procedures

Make the RA-915M mercury analyzer and the PC ready for operation according to 2.2. Before measurements, prepare the PYRO-915+ attachment as follows.

1. Switch power using the **On/Off** switch on the power supply and pumping unit. The attachment switches to the **Standby** mode, all coolers start running and the display shows the following message:

S	**T**	**A**	**N**	**D**	**B**	**Y**						

2. Press the **ENT** button. The attachment switches to the **Select** mode. The display shows the “Select” message and the mode which was used last (e.g., MODE 3):

S	**E**	**L**	**E**	**C**	**T**			**M**	**O**	**D**	**E**	**3**

3. With the ↑ and ↓ buttons choose the mode (mode parameters such as evaporator, afterburner and cell temperatures and air flow rate are given in Table A-1 in Annex A) according to the method of analysis (e.g., MODE 4):

S	**E**	**L**	**E**	**C**	**T**			**M**	**O**	**D**	**E**	**4**

4. Press the **ENT** button. The attachment starts operating in the selected mode (the heaters and the air pump switch over operating according to its settings) and the display shows the message:

M	**O**	**D**	**E**	**4**						**O**	**K**	**!**

⇨ **When operating in the selected mode (e.g., MODE 4) you can change it (e.g., to MODE 2). To do this, press the ESC button to enter the Selection mode while the heaters and the air pump keep operating according to MODE 4 parameters. Select a new mode using the ↑ and ↓ buttons and press the ENT button. The attachment starts operating in the newly selected mode.**

5. The OK! message will be displayed if the established operating parameters are in agreement with the settings for the chosen mode. Otherwise, an error message E1, E2 or E3, which can help to identify the cause of the failure (see clause 0), will be displayed.

6. Check the gas tract of the attachment for tightness. Open the sample port of the thermal chamber unit with the shutter handle, insert an empty boat with holder (i.e. without sample) in it, fix the holder by closing the sample port with the handle against stop. Pinch the silicone tube connecting the gas tee and the outlet absorption filter for about 3 s (see Fig.2-6). The E2 error message will appear instead of the OK! message. If the E2 error message fails to appear, check tightness of all connections, correctness of the quartz windows mounting onto the analytical cell as well as that of the boat in the sample port.

7. It takes 20 min to get the attachment ready for operating after the heaters started working. Check again the gas tract of the attachment for tightness after this time.

⇨ **Parameters of the attachment operation modes (evaporator, afterburner and analytical cell temperatures, air flow rate) are given in Table A-1 in Annex A.**

⇨ **Functionalities of the mode control buttons of the power supply and pumping unit are listed in Table B-1 in Annex B.**

2.4 Operational procedures

This section contains basic instructions for operation with the analytical complex. For more detailed instructions, refer to the RA-915M Mercury Analyzer Operation Manual and the Software RAPID User's Manual.

General procedure is as follows.

1. Assemble the analytical complex according to 2.2 and 2.3.

⇨ **Prior to sample analysis carry out the calibration of the analytical complex for the given sample type and specified working conditions (i.e. mode) in which sample analysis will be performed. Calibration should be carried out using (certified) reference materials with the established (certified) mercury content.**

2. Start operating the RAPID software, select ***Sample analysis*** mode and in the section **Operating cell** select *External* from the list. To create calibration, select **Calibration** operation mode of the software (see the Software RAPID User's Manual). To start analysis with the use of an existing calibration, select **Analysis** operation mode (see the Software RAPID User's Manual).

3. Prior to starting sample analysis, check the quartz windows of the analytical cell (see 3.1) and clean up the quartz boat. Open the sample port of the thermal chamber unit with the shutter

handle, insert the empty boat with holder (without sample) in it, fix the holder by closing the sample port with the handle against the stop and press the **Boost heating** button (see par. 2.5). If a peak appears, wait until it comes back to the baseline level. Remove the boat following the reverse procedure.

⇨ **If the response has not reteruned to the baseline level by the automatic termination of the Boost heating mode, continue the clean up procedure by pressing the Boost heating button again. Never use a boat unless the baseline level is reached.**

4. Put the known (by mass) amount of the sample into the cleaned boat. The mass of the sample should be in agreement with the requirements of the method used.

⇨ **Cool the quartz boat before putting sample in it.**

5. Open the sample port of the thermal chamber unit with the shutter handle, insert the boat with sample in it, fix the holder by closing the sample port with the handle against the stop. Record the analytical signal and process it according to the Software RAPID User's Manual.

⇨ **If a warning «Attention! ΔD > 2» appears, repeat the measurement with the sample mass 1.5-2 times less than the initial one (see the Software RAPID User's Manual).**

6. Turn on the **Boost heating** mode if necessary (see 2.5).

7. Open the sample port of the thermal chamber unit and remove the boat, close the sample port and remove the residue of the sample.

8. To carry out measurements for subsequent samples, repeat steps 3 - 7 of this section.

9. Press the **ESC** button twice to enter the **Standby** mode after finishing measurements for cooling the thermal chamber unit by

built-in fans (see Table B-1 in Annex B). The power supply and pumping unit can be switched off after 10-15 min cooling.

2.5 Operation in the Boost heating mode

The **Boost heating** mode is intended for the mercury recovery check during measurements, cleaning up quartz boats and step-by-step heating of the sample.

Press the **Boost heating** button on the power supply and pumping unit to enter the **Boost heating** mode (Fig.1-4, item 1) only when the attachment is operating in **Mode**. When pressing the **Boost heating** button, extra heating of the evaporator is applied for a specified period of time. After heating is completed, air flow rate automatically goes up to 3 dm^3/min (except for MODE5 and MODE8, see Table A-1 in Annex A). When the **Boost heating** mode is activated, the **Boost heating** button (Fig.1-4, item 4) glows. When the mode is completed, the glowing turns off. You can exit the **Boost heating** mode at any time by pressing the **ESC** button. The attachment will switch over to the **Select** mode.

When pressing the **Boost heating** button in MODE1, MODE2, MODE3, MODE4 and MODE5, the evaporator temperature increases approximately by 200°C according to the selected operation mode (Table A-1 in Annex A). Insert a new sample only after the **Boost heating** mode is completed.

When pressing the **Boost heating** button in MODE6, MODE7, MODE8, the evaporator heating turns on and the temperature increases stepwise up to 300-580°C on the last heating stage (Table A-1 in Annex A). Insert a new sample only after the **Boost heating** mode is completed. It is recommended to operate in MODE6, MODE7 or MODE8 with activation of the **Boost heating** mode for stepwise heating of the sample.

To check the recovery of mercury from the samples especially when operating in MODE3 or MODE4, do the following. Wait until the response returns to the baseline level under standard conditions for the chosen mode. Enter the **Boost heating** mode with the quartz boat still remaining in the sample port.

If a new peak appears on the graph, check whether the response returns to the baseline level within the period of extra heating (see Table A-1

in Annex A) for the applied mode or not. If this happens before the time of the extra heating elapses, the analytical signal (i.e. peak area) obtained in the **Boost heating** mode is considered as a reliable one. Compare the two peaks (i.e. for the standard conditions and for the **Boost heating** mode). Should the analytical signal for the **Boost heating** mode not exceed 10 % of that for the standard conditions, the analysis of similar samples requires no extra heating. Otherwise choose another mode with higher temperature of the first chamber or use the **Boost heating** mode for each sample.

If the response has not returned to the baseline level within the extra heating time, use another mode with higher temperature and check recovery as above.

⇨ **Consult table A.1 in Annex A and use the response graph or a stopwatch to asses time interwals.**

To clean up the quartz boat, proceed as laid down in 2.4 (step 3).

3 Technical maintenance

Preventative maintenance of the attachment is carried out in field and includes the following:

- Checking electric cords;
- Checking the gas tract of the attachment for tightness;
- Cleaning quartz windows of the analytical cell;
- Cleaning the sample port of the thermal chamber unit;
- Replacement of the inlet absorption charcoal filter;
- Replacement of the outlet absorption filter;
- Replacement of the quartz boat in the holder;
- Replacement of the sealing ring on the quartz boat.

Caution:

Perform all technical maintenance procedures when power supply voltage is switched off.

3.1 Cleaning quartz windows of the cell

Prior to starting sample analysis, check whether quartz windows of the cell are clean. Select the *External* operating cell in the ***Sample analysis*** window of the software RAPID, press the **START** button in the ***Sample analysis*** window and wait for about 60 s. Clean or replace with new ones the quartz windows if the SD value is higher than 3.

Clean or replace with new ones the quartz widows if the message «The results might be incorrect. The light intensity is too small» appears prior to measurements.

To clean the quartz windows do the following:

1. Unscrew the thumb screws fixing together the thermal chamber unit and the external optical unit;
2. Disconnect the thermal chamber unit and the external optical unit;
3. Carefully unscrew the mounts and take out the quartz windows (see Fig.3-1);

Fig.3-1 - Disassembling of the quartz windows of the analytical cell

4. Clean the windows by cotton wetted with a solvent (alcohol, acetone);
5. To remove dust from the cell, blow compressed air through the cell or use a vacuum cleaner;
6. Carefully clean the analytical cell by cotton wetted with a solvent (alcohol, acetone);
7. Remove solid particles from the cell surfaces with a brush prior to installing the window mounts on the analytical cell of the thermal chamber unit

Assemble the attachment in the reverse order.

3.2 Cleaning sample port of the thermal chamber unit

Clean the sample port of the thermal chamber unit if it is difficult to open and close it. In the case of active operation with the attachment, it is recommended to perform cleaning at least once a month. To do this, proceed as follows:

1. Remove the sample port lid fixed on the thermal chamber unit by magnets as shown in Fig.3-2;

Fig.3-2 - Disassembling of the lid of the sample port

2. Move the latch bar to any side (e.g. to the right) and take it off as shown in Fig.3-3;

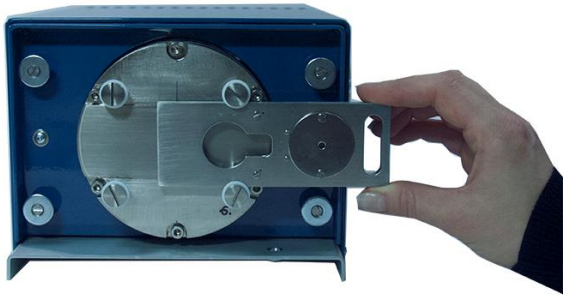

Fig.3-3 - Moving of the latch bar

3. Remove solid particles by a brush. Wipe all the rubbing parts by a cloth wetted in alcohol;

4. Install the latch bar in the guides and move it to the left so that its central hole will be positioned against the hole in the sample port of the thermal chamber unit. The Teflon spacers should be placed on the side of the port lid;

5. Set the handle of the latch bar drive in the «closed» position;

6. Put the lid of the sample port on to its place so that the pin on the handle fits in the slot in the latch bar.

3.3 Replacement of the inlet absorption charcoal filter

The inlet absorption charcoal filter should be replaced at least once a year.

To replace the filter unscrew four screws fixing metal grid that retain the inlet absorption charcoal filter. Take off the protective metal grid, change the filter (as shown in Fig.3-4). Put the metal grid on its place and firmly fix it with the screws.

Fig.3-4 - Replacement of the inlet absorption charcoal filter

3.4 Replacement of the outlet absorption filter

The outlet absorption filter should be replaced at least once a year. Spare filter is supplied in the delivery set of the attachment.

3.5 Replacement of the quartz boat in the holder

Replace the quartz boat in case of cracks, chips and other damage of the boat. Spare boats are supplied in the delivery set of the attachment.

To replace the quartz boat in the holder, release the screw in the holder (Fig.3-5, item 1) and remove the boat. Insert a new boat in the holder so that the holes in the holder and in the boat coincide and firmly fix the screw.

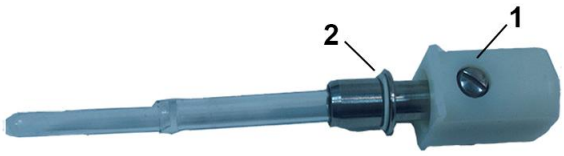

Fig.3-5 – The quartz boat with holder

1 – Screw,
2 – Sealing ring.

3.6 Replacement of the sealing ring on the quartz boat

Replace the sealing ring on the quartz boat (Fig.3-5, item 2) if its wear does not allow achieving the proper tightness of the gas tract (see 2.3). Spare rings are supplied in the delivery set of the PYRO-915+ attachment.

4 Possible failure and troubleshooting

The PYRO-915+ attachment should be repaired at an authorized service centre or by the manufacturer only.

Refer to Table 4-1 for possible causes of minor malfunction and find tips how to deal with them. Other cases of malfunction please advise your Supplier or the Manufacturer and follow the instruction received.

Table 4-1

Fault symptom	Possible cause	Remedial action
The attachment does not turn on	Power cord is out of order	Repair power cord or check its connection
	The fuse in the power supply and pumping unit is blown	Replace the fuse (Fig.1-5, item 8)
The E1 error message is displayed (Problems with power supply of the attachment)	Power cord of the thermal chamber unit is out of order	Check the power cord and its connection to the thermal chamber unit
	The main voltage is out of the required range	Check the mains voltage
The E2 error message is displayed (Problems with air flow of the attachment)	The connection of air tubes is pinched	Check if the tubes are released
	The outlet absorption filter is clogged	Replace the outlet absorption filter with the new one (see Par. 3.4)
The E3 error message is displayed (Problems with power supply and air flow of the attachment)	The same as for E1 and E2 errors	The same as for E1 and E2 errors
When the **Start** button in the RAPID window is pressed prior to measuring the analytical signal SD value is more than 3 or the error message «The results might be incorrect. The light intensity is too small» appears	The quartz windows are dirty	Clean the quartz windows (see Par. 3.1)

5 Storage and Transportation

Only the attachment which is packed according to the requirements given in 2.1 can be transported.

The attachment may be transported by any kind of transportation without the limitations in speed and distance under the following conditions:

- Ambient air temperature from minus 50℃ to 50℃
- Relative humidity up to 100% at 25℃.

Placing and fastening of boxes with the attachments on transportation vehicles should guarantee the steady position throughout the delivery, absence of displacements and mechanical shocks. Instructions given by cargo signs should be followed at all stages of the delivery from the manufacturer to the customer.

Attachment storage conditions within the transportation box:

- Ambient air temperature from 5℃ to 40℃
- Relative humidity not more than to 80% at 25℃.

Should other conditions be applied, they must be specified in the contract for the supply.

The content of dust, fumes of acids and alkalis and other corrosion-active agents should not exceed the content of those for laboratory premises.

During the storage period, the attachment should be placed so that distance to the walls of the room should be not less than 0.1 m, distance to heating devices should be not less than 0.5 m.

6 Warranty

The Manufacturer warrants each attachment complies with the Specification given in this manual if the customer observes the rules of operation, transportation and storage conditions established by this Operation manual.

For more information please refer to Certificate of Quality 951.07.00.00.00 CQ.

Annex A – Parameters of the attachment in different modes

Parameters of the attachment operating in the standard and the **Boost heating** modes as well as recommendations for selection of mode for some types of samples are listed in Table A-1.

Temperature of the second chamber of the atomizer (afterburner) is 650-750°C.

Temperature of the analytical cell is 680-730°C (610-670°C for MODE5, MODE8).

Table A-1

Operation mode	Air flow rate, dm^3/min	First chamber of atomizer (evaporator) temperature, °C	Recommended samples	Boost heating mode		
				First chamber of atomizer (evaporator) temperature, °C	Extra heating time, s	Cooling time, s
Mode1	0,8-1,2	680-740	Soil, sediments, ores and minerals, coal, foodstuff	770-830	60	30
Mode2	0,8-1,2	520-580	Soil, water solutions, foodstuff	680-780	70	50
Mode3	0,8-1,2	370-430	Foodstuff, water solutions	580-730	80	70
Mode4	0,8-1,2	170-230	Samples with weakly bound metal mercury	480-630	90	90
Mode5	2,5-3,5	560-620	Soil, sediments, ores and minerals with high content of Hg (more than 5 ppm)	650-750	60	40
Mode6*	0,8-1,2	170-230	Gasoline, kerosene, naphtha	350-450**	150	70
Mode7*	0,8-1,2	370-430	Naphtha, crude oil	550-700**	110	70

Operation mode	Air flow rate, dm^3/min	First chamber of atomizer (evaporator) temperature, °C	Recommended samples	Boost heating mode		
				First chamber of atomizer (evaporator) temperature, °C	Extra heating time, s	Cooling time, s
Mode8*	2,5-3,5	150-210	Samples with high content of mercury (from 20 ppm to 300 ppm)	450-600**	240	120

* When operating in MODE6, MODE7 or MODE8 the **Boost heating** mode should be turned on providing gradual evaporator heating.

** Temperature of the evaporator on the final heating step when the **Boost heating** mode is activated.

Annex B – Functionality of the mode control buttons of the power supply and pumping unit

Functionality of the mode control buttons of the power supply and pumping unit are listed in Table B-1.

Table B-1

Mode	**Buttons**					
	↓	↑	←	→	ENT	ESC
Standby					Goes to **Select**	
Select	Selects mode number	Selects mode number			Goes to **Mode**	Goes to **Standby**
Mode			View the parameters	View the parameters		Goes to **Select**

You can view actual parameters on the display of the attachment by consecutive pressing the ← and → buttons when operating in **Mode**. Displaying of the operation parameters is used in the attachment service adjustment and maintenance. E.g. view of the display showing the flowing rate is:

M	**O**	**D**	**E**	**3**		**Q**	**=**	**1**	**0**	**3**	**:**	**O**	**K**	**!**