THERMOSTEP

ELTRA
Analysers made in Germany

SERVICE MANUAL

ELTRA GmbH Mainstr. 85 Block 20

41469 Neuss
☎ : +49 2137 - 12822
Fax: +49 2137 - 12513
analysers@eltragmbh.com
www.eltragmbh.com

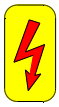
NOTE :

This Service Manual serves as a support for service operations at Thermostep analyser of the company ELTRA. For further questions and support please contact the service technicans of the manufacturer.

In this Service Manual, no information from the Operation Manual is repeated, however it is provided as established.

The service should be done only by persons who have mastered the servicing and maintenance of this device, as well as having further qualifications, especially in the areas of electronics and physics.

We ask the users of this Service Manual bring to our attention any possible mistakes. We would also appreciate any suggestions for supplements and improvements to this Service Manual.



CAUTION !

Before opening this device, always unplug the main power !

SERVICEAMANUAL
Thermostep TGA

1. Starting Up

2. Malfunctions

3. Service

4. Miscellaneous

1. Starting up

Please note that first start up of Thermostep-analyser has been done already before delivery of the instrument. The following described operations are **not necessary** to be done before the first analysis.
By reason that a lot of service operations needs a new start up for the according component and for a better understanding of the working instructions the start up is described here detailed. For starting of the analyser it is necessary that the computer is connected and that the software has been started. Please open and remove the lower side panels of the instrument then removing ground cables. If not mentioned different the components are behind the lower side panels. It is recommended to read the working instruction once completely and to follow it step-by-step!

1.1 Installation of Carousel adaptor

Required tools: 2,5 mm Allenkey

The carouseladaptor is located centrally at the lower heating element inside the furnace. It is necessary for rotation and lifting up and down of the crucible- and lidcarousel. The carousel-adaptor should be centrally at the notch and horizontally above the lower heating element.

a.) Open the cover of the analyser.
b.) Plug the carouseladaptor through the notch in the lower heating element at the guidance at the interior of the analyser. (see Fig. 1.1)

Fig. 1.1.: Carouseladaptor – inserted at the lower heating element

c.) Fasten the carouseladaptor with the 4 x 2,5 mm screws (respectivly 2 screws at 90° shifted) through the two openings at the guidance (LHS). To fasten the screws move the carouseladaptor until the screws are visible at the openings (see Fig. 1.2).

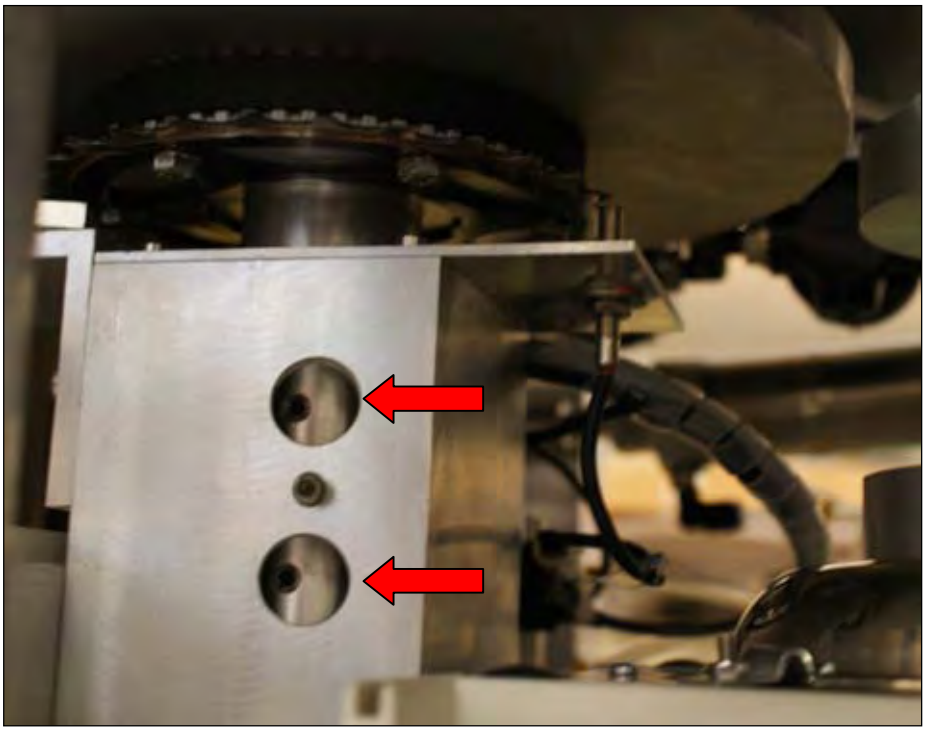


Fig. 1.2.: LHS – Guidance of Carouseladaptor (screws marked by red arrows)

If the carouseladaptor not located centrally at the notch of the lower heating element it has to be **adjusted**, to avoid it rubbing at the borders of the notch!

Required tools: 2,0 mm Allenkey (angulate)
2,5 mm Allenkey
4,0 mm Allenkey

d.) Remove the metal sheet round the lower heating element (inside furnace) by loosen 6 x 2,0 mm screws (respectivly 3 screws at the left or rather at the right border of the metal sheet) and 2 x 2,5 mm screws in front of the internal blower (see Fig. 1.3).

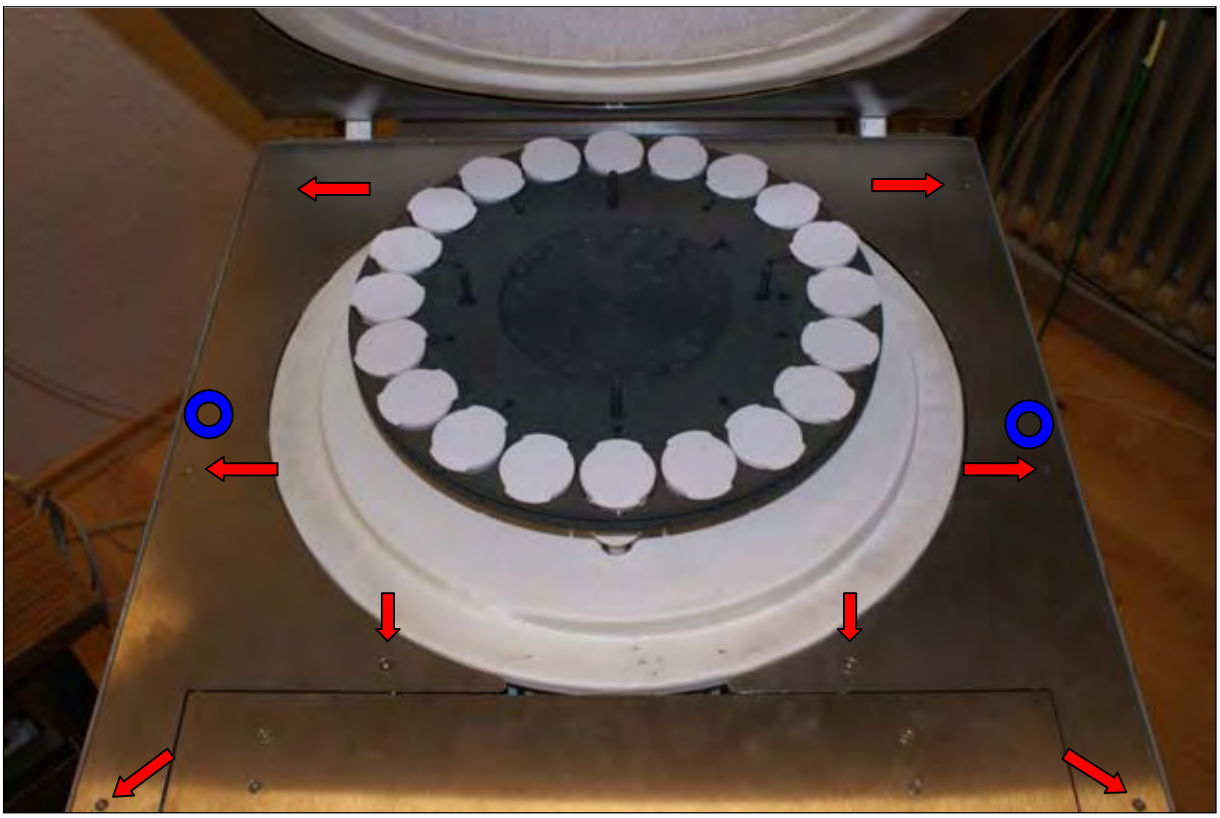


Fig. 1.3.: FI – Steel surround of the lower heating element (screws marked by red arrows; blue spots mark screws below metal sheet)

e.) Unfasten (not loosen completely!) the 2 x 4,0 mm screws below the metal sheet (see blue spots at Fig. 1.3).
f.) Slide or pitch the carouseladaptor to correct position.
g.) Fasten the 2 x 4,0 mm screws to fix the carouseladaptor at the position.
h.) Fasten the metal sheet again.

1.2 Insertion of Carousel, Speed of lifting up and down, Sensors

Required tools: Screwdriver

The crucible- and the lid-carousel are needed to carry and station the crucibles respectively and lids during analysis. The lifting up and down of the carousels is controlled by sensors, that inspect the actual status of the paricular carousel (**up** or **down**; see Operationmanual: Form - Controller).

a.) Put the crucible-caroussell with the openings at the appliance of the carousel-adaptor.
b.) Lift the carousel up and down and observe the speed of the movement (see Operation manual: Form – Controller).

Please note: The carousel should be moved as slowly as possible without jerk to keep pedestal of the balance free of vibration. Vibrations of the pedestal would disturb or prolong the weighing during analysis, because the balance would need longer time for stabilization. Same method is essential for lidcarousel.

Each carousel is moved by its own cylinder. Every cylinder has a sensor, that sense and report the actual status of the respective carousel (see Operationmanual: Form – Controller). The carouselsensors are small black boxes fixed at the cylinder by a screw. For proper working of the sensors during analysis they should be adjusted at the middle of their working area.
Next to the sensors each cylinder has two chokes, that can be used to regulate the speed of lifting up or down of the carousels.
The cylinder of the crucible-carousel can be reached from LHS and is located behind the carouseladaptor. Its sensor is provided at the left side of the cylinder.
The cylinder of the lid-carousel can be reached from the RHS and is located next to the carouseladaptor. Its sensor is provided at the frontside of the cylinder.

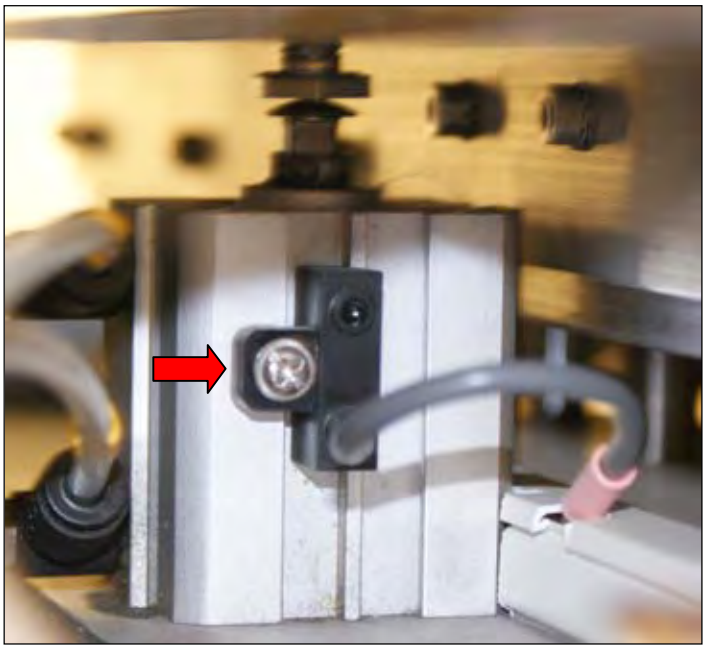


Fig. 1.4: Cylinder of Carousel with sensor (sensor marked by red arrow)

The adjustments for both sensors are analog.

c.) To adjust the sensor open Form Controller at the software TGA. At **Inputs** the actual status of the carousel is been shown. Please make sure that the carousel is lifted up (**Inputs:crucibles up** marked respectivly **Outputs: crucibles down** not marked), by deactivate **Outputs: crucibles down** if necessary.
d.) Loosen the screw that fixes the sensor at the cylinder until you can move the sensor.
e.) Slide the sensor slowly upwards until the mark at **Inputs:crucibles up** disappears. At the point were the marking disappears the detection area of the sensor ends.
f.) Mark the upper boarder of the detection area.

Please note: If there is no mark visible (**Inputs: Crucibles up**) before the adjustment of the sensor it is completely outside of its detection area. In this case move the sensor upwards or downwards until you see a mark at the software and follow instrution from e.).

g.) Now move the sensor downwards (the mark appears again) until the marking disappears again. Mark the lower border of the detection area, as well.
h.) Site the sensor nearly at the middle of the detection area and fix the screw again.

i.) Control the correct position of the sensor by lifting up and down the caroussell and check if the status is indicated correctly by the software.
j.) Use the same method for the sensor of the lid-caroussell.
k.) Adjust the speed of the considered caroussell by the particular choke (upper choke: up; lower choke: down). You reduce speed by closing the choke more and vice versa.
l.) The setting of the chokes should be fixed by the lock nut.
m.) Control the correct speed after locking again!!!

1.3 Measurement of grounding conductor resistance

For reasons of safety the check of the grounding conductor resistance is done before delivery. For measurement of the grounding conductor resistance you need an appropriate electric measuring instrument. Check all metal surfaces of the instrument.

1.4 Measurement of insulating resistance

For reasons of safety the check of the insulating resistance is done before delivery. For measurement of the insulating resistance you need an appropriate electric measuring instrument. Follow the instructions of the measuring instrument.

1.5 Installation of PC

The PC is needed for the controlling of the Thermostep-analyser and for coordination of the analysis. For installation of the PC look at the Operation Manual: Start up.

1.6 Programming of Balance, Adjustment of glass chimney

The balance resides inside the TGA (Display: LHS; cable: RHS). The weighing is done by the pedestal, that reaches the balance at the interior of the analyser. At the scale plate an adjustable glass tube is assembled, that should reach up to 5 mm to the underside of the lower heating element. It is important that the height is adjusted correctly.

a.) The glass tube is build of two parts connected via a ring. To adjust height of the tube loosen the screw of the ring (LHS) and slide the upper part of the glass tube carefully upwards.

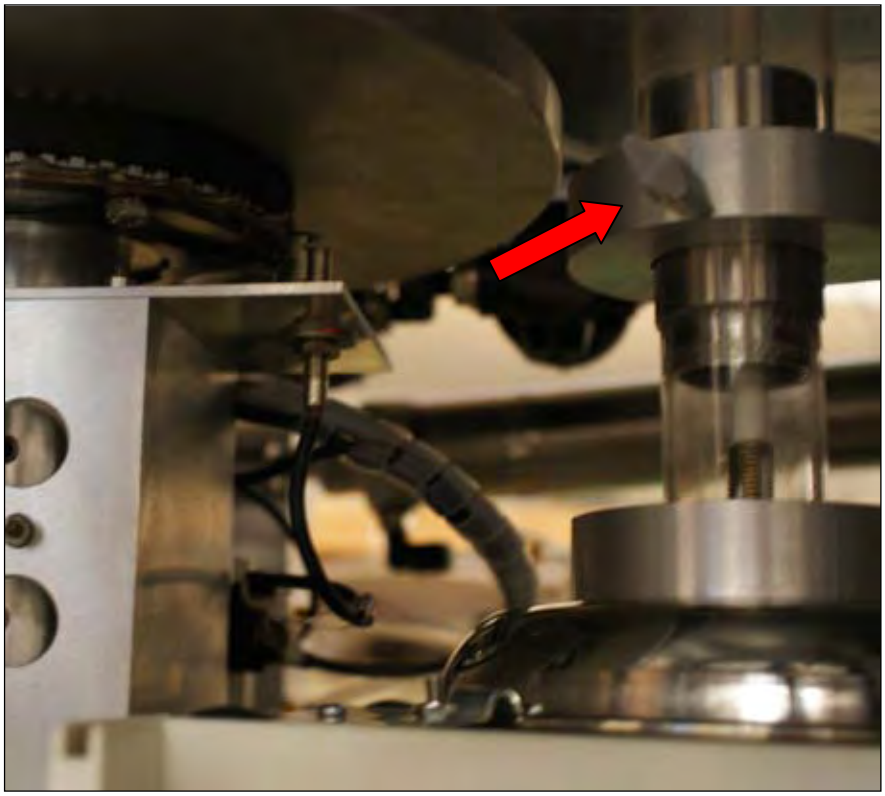


Fig. 1.5: LHS – Glass chimney of the balance (screw of the ring marked by red arrow)

For correct analysis results it is important to avoid rubbing of the balance pedestal at the borders of the notch at the lower heating element.

b.) To arrange the pedestal at the notch loosen the screw at the upper left edge of the board and hinge it down (RHS).
c.) At the underside of the balance there are two adjustable feet, that can be turned simultanously to move the pedestal at the right position.

For the weighing and effective analysis it is necessary to program the balance. For programming of the balance please read operation manual of the balance. The required allocations for the use of the balance at Thermostep are:

1.1.4 unstable surroundings
5.1.7 9600 Baud
6.1.3 auto sense stability

1.7 Control of voltages

Required tools: voltage measuring device

These are the different supply voltages of the controller of the analyser. These are shown at form Status and support the following components:

24 V: supply voltage of the board
18 V: supply voltage of the balance (not measurable)
12 V: supply voltage of the board

The voltages were measured with a voltage measuring device at the points TP1 (ground) and TP2, TP3 respectivly TP4 at the board (see Fig. 1.6). TP2 should show about 24V and TP3 should show about 12 V. TP4 is the supply voltage of the thermocouple and should show about 5V. (This voltage is not shown at form Status!) This voltage is adjustable at the potentiometer **R9** with a small screw driver.

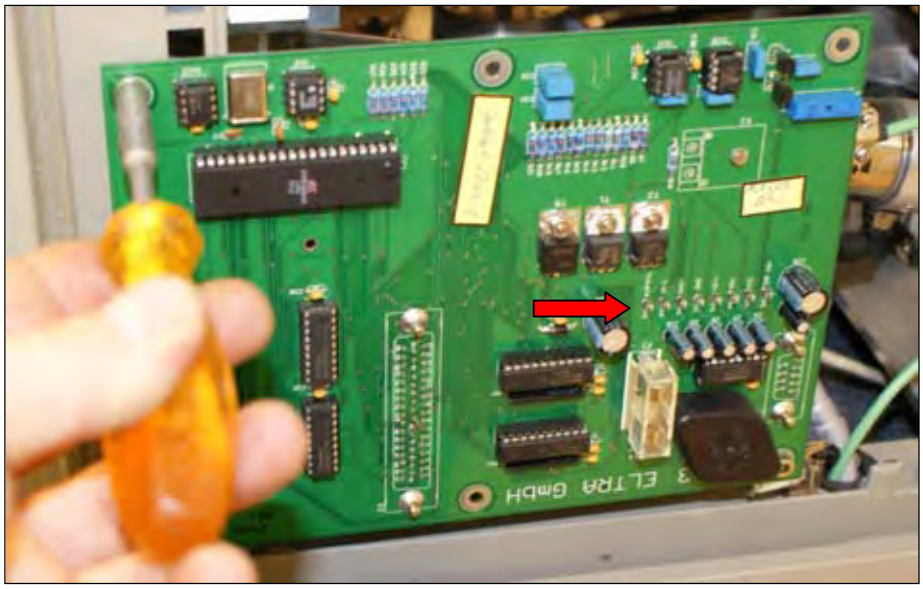


Fig. 1.6: RHS - Main bord (voltage measuring points marked by red arrow)

1.8 Measurement of reference temperature

Required tools: voltage measuring device

The reference temperature is used as an alignment of the thermocouple and is ascertained via the adjacent voltage at TP6.
Use the voltage measuring device at TP1 (ground) and TP6 and read the determined voltage. This voltage equates a temperature, that you can check at the enclosed index and indicates the proper functionality of the thermocouple.

1.9 Regulation of gaspressure, flow

During an analysis it is possible to create a Nitorgen- or Oxygen-atmosphere at the furnace. For this the selected gas is fed through feed pipes at the upper heating element. The gas pressure can be read at the pressure manometer at the frontside of the analyser and should be about 1,5 bar. The gasflow can be read at the flowmeter and should be about 400 l/h. Before you start to adjust the gaspressure make sure that the gas bottle pressure of your Nitorgen and Oxygen is sufficient!
The adjustment of the gaspressure is done by the according pressure controller at the LHS (Please note: TGAs with two cylinders for lifting the cover have the gaspressure regulators at the RHS). The front pressure controller regulates the Oxygen- and the rear pressure controller regulates the Nitrogen pressure.

a.) For examination of the gaspressure activate the particular gas at form “Controller” and check the pressure at the pressure gauge.
b.) To adjust the gas pressure extract the pressure controller and turn it until the required pressure is reached.

c.) After finishing the adjustment lock the pressure controller back in to avoid an accidentially alteration of the pressure.

The flow should be controlled simultaneously and is be adjustable by using the inlet needle valve at the frontside of the analyser. Please note that variation of the flow implicates a variation of the gaspressure. The adjustment of the flow should be secured by the counter nut at the choke to avoid accidential alteration of the flow rate.

1.10 Purging ventiles

The exits of the purging pipes are at the upper heating element and are needed to feed in the particular gas in the furnace during analyis. The gas discharging to the furnace is controlled by the software. To check the function of the purging switch on the gas flow manually (see Operator manual: Form - Controller) and check on the basis of the sound and using a suitable medium if the gas flows through both exits at the furnace.

Fig. 1.7: FI – Purging port at the upper heating element

1.11 Internal blower

The internal blower reduces the cooling down phase after finishing the analysis and is located at the front inside the furnace. After finishing the analysis it is lifted up automatically at a temperature of 300° C and closed into its standby position again after reaching room temperature and finishing cooling down time (see Operation manual: Form - Configuration).
The lifting up and down should occur in a moderate speed. Please note that the cover probably will be closed after finishing cooling down phase (depending on setting at Form – Configuration). The closing speed should be fast enough to avoid collision with the cover.

WARNING: The internal blower start automatically after lifting up! **RISK OF INJURY!!!**

a.) Activate the blower at form "Controller" (see Operation manual) to lift it up and check speed of lifting up and closing.

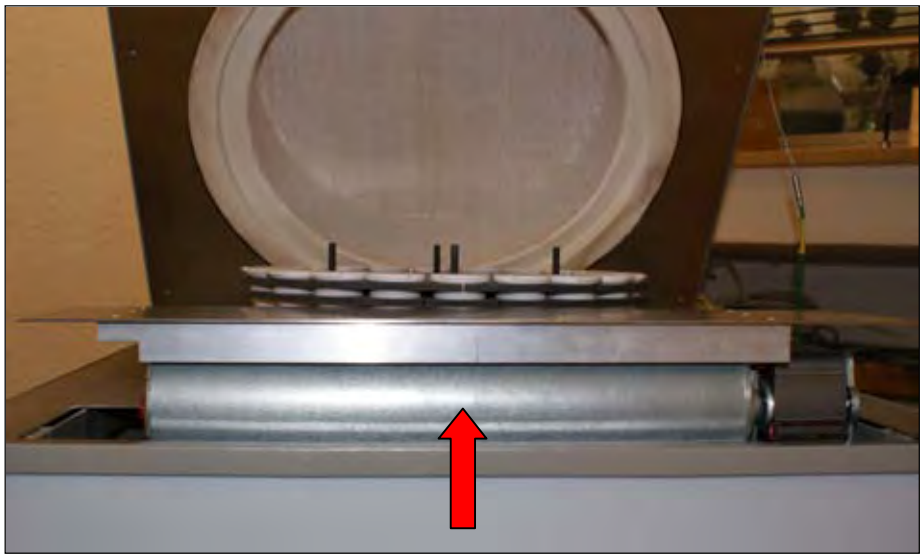


Fig. .1.8.: FI - Internal Blower (lifted up)

b.) Adjust the speed of lifting up by using the upper choke at the 1. valve of the valveblock at the LHS.
c.) Adjust the speed of discharging by using the lower choke at the 1. valve of the valveblock at the LHS.
d.) Lock the adjustment via the counter nuts.
e.) Check speed after locking again as described at a.).

1.12 Motorsensors

Required tools: 8 mm open-end wrench

The analyser uses a stepper motor that is controlled via two sensors, the home sensor and the move sensor. The homesensor coordinates the rotation of the carousel and the positioning of the crucibles at the balance pedestal. At this the encoding screw, that is fitted onto the encoding plate, serves as start- and endpoint of a rotation. During rotation of the encoding-screw the sensor completes the revolution and starts to incorporate the steps of the new revolution.

The home sensor (horizontal arrangement) is located at the LHS at reach of the encoding plate, that rotates simultanously with every carousel revolution and is fixed at the carouseladaptor. The homeposition is defined by the encodingscrew fitted at the encodingplate. For recognition of the encoding screw the distance of the homesensor should be as low as possible. At optimal alignment a sheet of paper (80g) should fit between sensor and encoding screw. Plese note that the scew has a wide surface area. A collision between screw and sensor has to be avoided at any time!
The distance and the vertical position of homesensor is adjustable.

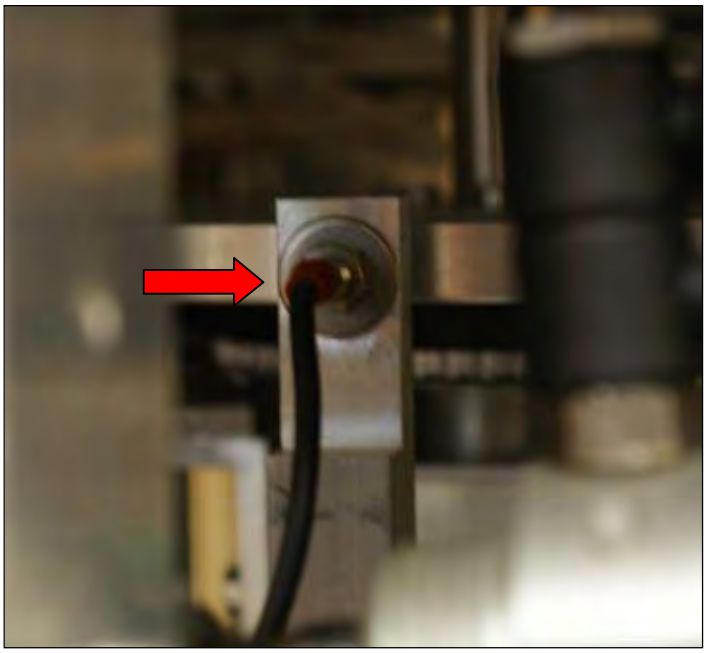


Fig. 1.9: LHS - Homesensor

a.) Unfasten the nut in front and behind the fitting with the aid of the 8 mm open-end wrenchs.
b.) Position the encoding screw in front of the sensor.
c.) Aim the sensor at the correct distance to the encoding screw.
d.) Tighten the nut in front of the fitting to fix the distance of the sensor.
e.) Aim the sensor to the correct vertical position (nearly centrally to the encoding screw).
f.) Fasten the nur behind the fitting.
g.) Controll right position of the sensor for a contactless passage with the encoding screw by moving the encoding plate carefully by hand.
h.) Check correct position and function of sensor by software.

The move sensor controls that an undisturbed rotation can take place, to avoid a damage of the analyser due to collision.
The movesensor (vertical arrangement) is located to the frontside of the analyser at the guide bar of the carousseladaptor. It is fixed with two nuts and should be close to the cogwheel below the encoding plate. To assure an undisturbed revolution the sprockets are registered by the sensor. It stops the motor if time of recognition is exceeded, to avoid a ripping of the gear belt or overheating of the motor in case of jam.
The sensor has to be positioned under the spike of the sprockets, so that its possible to recognize accurately the difference between sprocket and clearance. The distance between cogwheel and sensor should be as low as possible. The adjusting of the move sensor uses same procedures the adjusting of the homesensor. To avoid a damage of the sensor, but to reach an optimal distance to the cogwheel, move the cogwheel after adjusting the sensor by hand. A complete rotation should take place to be sure that every sprocket is able to pass the sensor without touching.

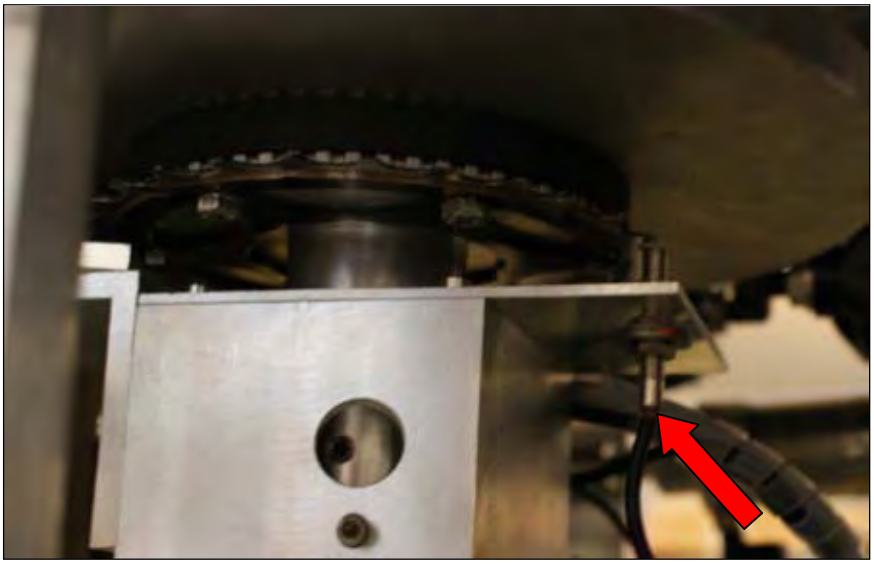


Fig. 1.10: LHS - Movesensor

1.13 Calibration of homeposition

Required tools: 2,5 mm Allenkey

The correct adjustment of the motorposition assures the optimal siting of the crucibles at the balance pedestal. The steps that the motor should do after passing the homesensor to siting the crucible centrally at the pedestal are adjusted here.
For a complete rotation of the caroussel the motor does 32000 steps and the distance between two crucibles is 1600 steps. The optimal calibration is 800 steps, whereas calibrationvalues between 600 and 1000 steps are tolerable. The siting of the first crucible directly over the homesensor is not useful (calibrationvalue <600), because the homesensor do not detect a single point but an area and the accurate siting of the crucible at the balance would be more difficult.

a.) Open form "Motor" (see Operation manual).
b.) Click at **Read**. The saved calibration value is shown (before first starting up: 1). At a calibration value of 1 the caroussel is positioned over the pedestal between two crucibles.
c.) Enter **800** as calibration value and confirm it by clicking at **Save**. You will get a confirmation that the new calibration value is written to the memory.
d.) Click at **Home**. Caroussel is rotated to position 20.
e.) Put a crucible at the caroussel and let it move over the pedestal, by entering the corresponding crucible position at the text box and clicking at **Go** afterwards.
f.) Lower down the caroussel (see Operation manual: Form – Controller) and check if the crucible is sited centrally at the pedestal.
g.) If a slight displacement of the crucible at the pedestal it is needed to change the calibration value. If the crucible is set to far lower the calibration value and vice versa.
h.) Lift up the caroussel again.
i.) Enter the new calibration value and save it like described at c.). Follow the instructions again.

If correct siting of the crucibles is not possible by using a calibration value between 600 and 1000 it is necessary to adjust the carusseladaptor.

j.) Lower the crucible onto the pedestal and check if the crucible is sited to far or not far enough to decide at which direction the carousseladaptor has to be adjusted.
k.) Do a complete rotation of the caroussel and check by sight at which crucible positions the screws for fixation of the carousseladaptor a located (LHS). For easier determination of the positions you can interrupt the rotation by clicking **STOP** as soon as the screws become visible and read the crucible position at the screen.
l.) Unfasten the screws via 2,5 mm allen key. (The carousseladaptor is fixed with 4 screws, two pairs shifted at 90°).
m.) Repeat l.) with the second pair of screws.
n.) The carousseladaptor should be now moveable independently from the motorrotation. Move the caroussel slowly at the needed direction.
o.) Fasten the screws again.
p.) Check the crucibleposition again like described under c.)- d.) and correct via calibrationvalue when necessary.

1.14 Control of cushioning

The cushioning function is necessary to open the cover of the analyser completely. To reduce the cooling down phase after analysis, the furnace is opened at a temperature of 650° C 15 cm wide, before the cover is opened completely at 500° C. At a temperature of 300° C the internal blower is started to speed up the cooling. After reaching room temperature the cooling will be continue for the chosen cooling time (see Operation manual: Form – Configuration: **Cooling time**) to make sure, that all parts of the furnace are cooled down completely.
To interrupt the opening of the cover at a certain point and to keep it there, the cushioning fuction is switched off after passing the backward sensor to avoid the complete opening of the cover.

a.) To check this function close the cover (see Operation manual: Form – Controller).
b.) Activate function **Cover open up** at Form Controller and click several times at **Cushioning** until cover is opened a gap wide.
c.) Notice if cover stays at the reached position. (A movement of the cover from this position possibly occurs very slowly and not promptly.)
d.) If cover does not stay at the half opened position close choke at the backside of the 2. valve at the valveblock (LHS) completely.
e.) Check function again.

1.15 Opening and closing of cover, sensor adjustment

Required tools: 2,5 mm Allen key

Opening and closing of the cover proceeds from many processes automatically. A manual controlling of this function is possible at Form – Controller. The movement of the cover is accompanied by an accustic signal and should happen at a moderate speed. The movement is done by a cylinder that is located at the LHS of the analyser.
(An exeption are instruments that don't have the opportunity to assemble the exhaust air tube alternatively at the side. These instruments have two cylinders to open the cover each at every side. The cylinder at the RHS has two sensors, that control the status of the lid, whereas at the cylinder at the LHS two chokes control the speed of the movement.)

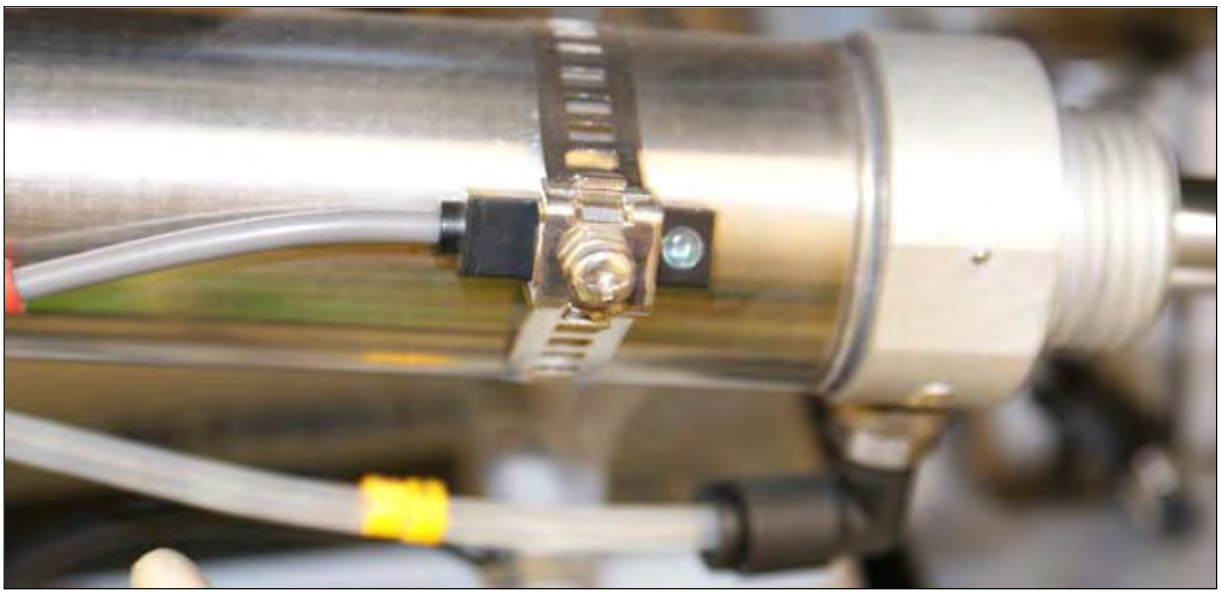


Fig. 1.11: RHS – Sensor of cover

a.) Check if the actual status of the cover is shown at Form – Controller (**Inputs**) correctly! (The front sensor register if cover is open, whereas rear sensor registers if cover is closed!)
b.) Unfasten the screw that fixes the respective sensor (depending on actual status of the cover) to slide it along the cylinder and push sensor to end of the cylinder out of its detection area.
c.) Move it along the cylinder (direction: middle of the cylinder) and note on the display at form Controller! Move the sensor until the acitvation of the respective function appears to find the border of the detection area.
d.) Mark this border.
e.) Move the sensor further along the cylinder over the detection area until the activation disappears again to find the other border of the detection area.
f.) Mark this border aswell.
g.) Slide sensor approximately at the middle of the detection area and fix it there by fasten the screw.
h.) Control the correct position of the sensor through opening and closing the lid. To control closing of the cover run cushioning function additionally (see **1.14**) and pay attention for activation resp. deactivtion of cover closing. At correct sensor position the marking disappears and don`t appears again during opening the cover.

Please note that for this adjustement you have to close or to open the cover depending of the sensor you want to adjust.

i.) Open and close the cover to control the speed of movement!
j.) Regulate the speed via the chokes at the cylinder. The upper choke regulates the closing speed and the lower choke regulates the opening speed (see Fig. **1.12**).

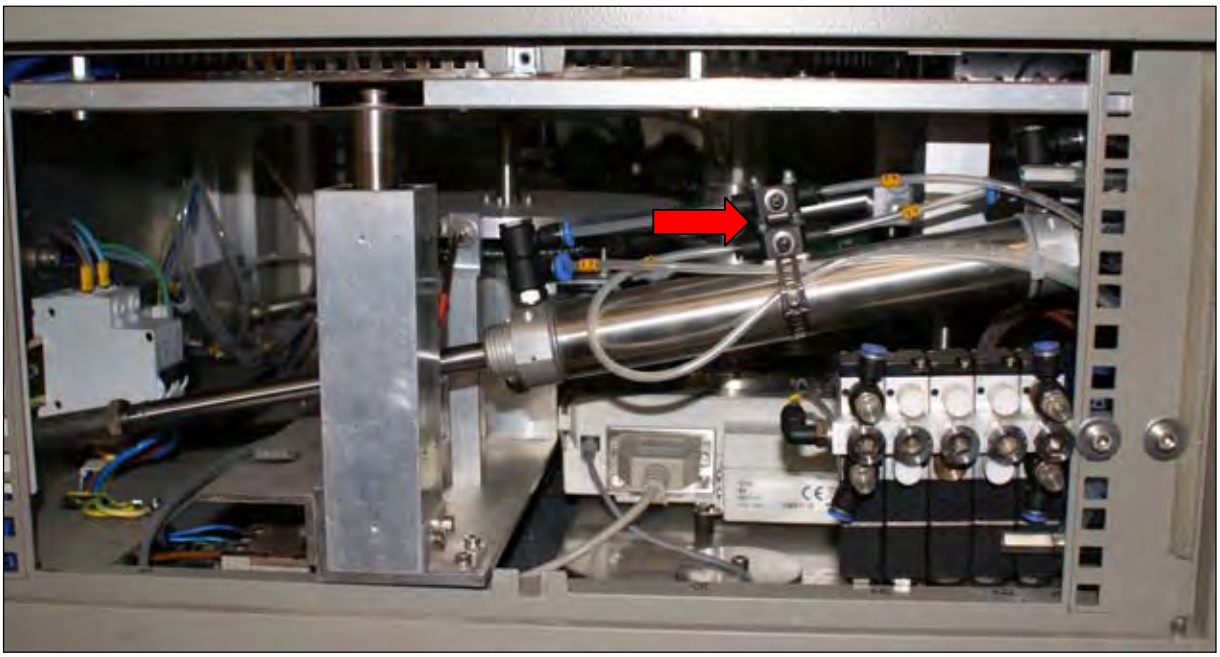


Fig. 1.12: RHS – Chokes of cover

k.) Lock your adjustments with the counter nuts.
l.) Check speed after countering again.

1.16 External blower

Required tools: Screwdriver

The external blower is necessary for cooling of Thermostep during analysis and for several of emerging flue gases.
The exhaust air tube can be assembled at the backside (see Fig. 1.13) or at the interior of the analyser.

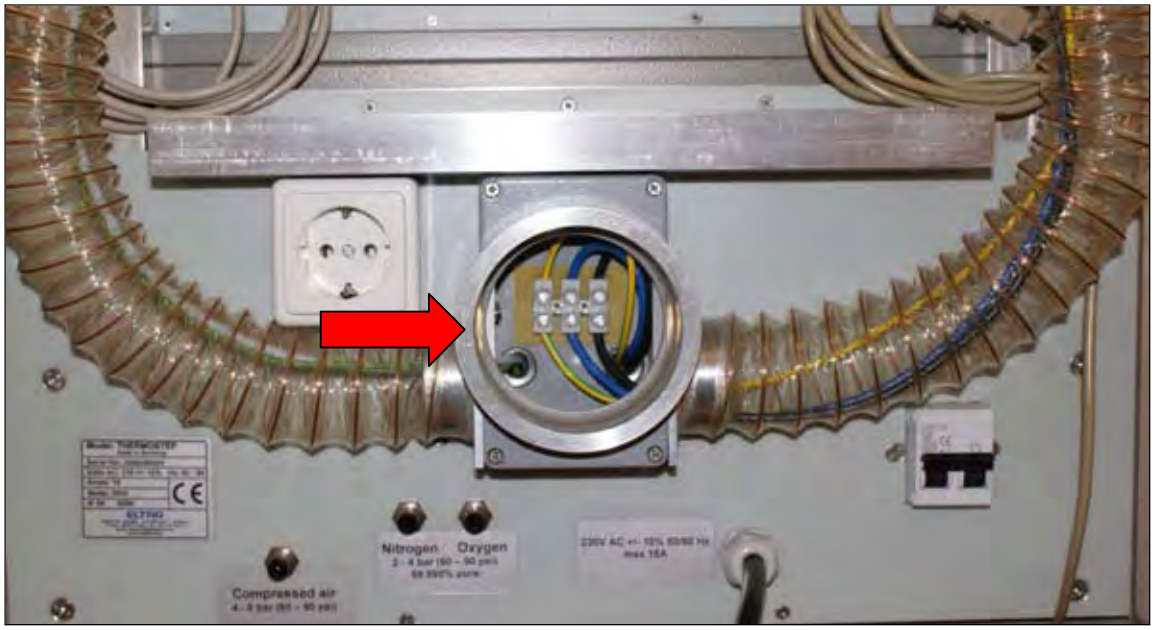


Fig. 1.13: BS – Connector for exhaust air tube

From the interior of the instrument the tube is passed through the specified notch at the left lower side panel (Fig. 1.14).

Fig. 1.14: LHS – Lower side panel with notch for exhausting aur tube

The not used connecting piece is closed with the provided cover cap. The exhaust air tube will be put on the connecting piece and fixed with the clamp provided. Lead the exhausted air into an adequate exhaust vent installation.
Plug the dimmer at the socket at the backside of the analyser (see Fig. 1.13). The external blower starts automatically when it is connected to the dimmer and the Thermostep is switched on.
Via dimmer you have the opportunity to adapt the power of the external blower. Optimal setting is approximately half dimmer power. If the chosen power is to low analyser is not cooled enough during analysis and bad odours emerge. At this case adjust power more.
Too high dimmer power reduces the Oxygen- or Nitrogen purge inside the furnace and results of analysis varies. Adjust the power lower at this case.

2. Malfunctions

If a malfunction occurs during analysis, an error message is shown at Form – Flow accompanied by a permanent accustic signal. In the following the error message and the error situation is described followed by a description how to correct it. The troubleshooting is listed at frequency of its appearance, so it is recommended to check them at the listed sequence.

2.1 Initializationtest failed

After starting software a TGA initialisation test checks functionality of the analyser. For progress through this test Thermostep has to be switched on (position 1 or 2). The test checks the single fuctions one after another and interrupts when an error occurs. Depending at which function the test is interrupted it maybe necessary to open the analyser manually (see Operation manual: Form – Controller), because the cover doesn't open until the test is completed.

The test checks the below functions:
a.) Availability of compressed air
b.) Communication between balance and PC
c.) Functionality of the balance
d.) Communication of Thermostep control unit and PC
e.) Availability of Nitrogen and Oxygen
f.) Functionality of Outputs

At a.)
Error message: "No compressed air!"

Check the availability of compressed air and the gas tube to the analyser!

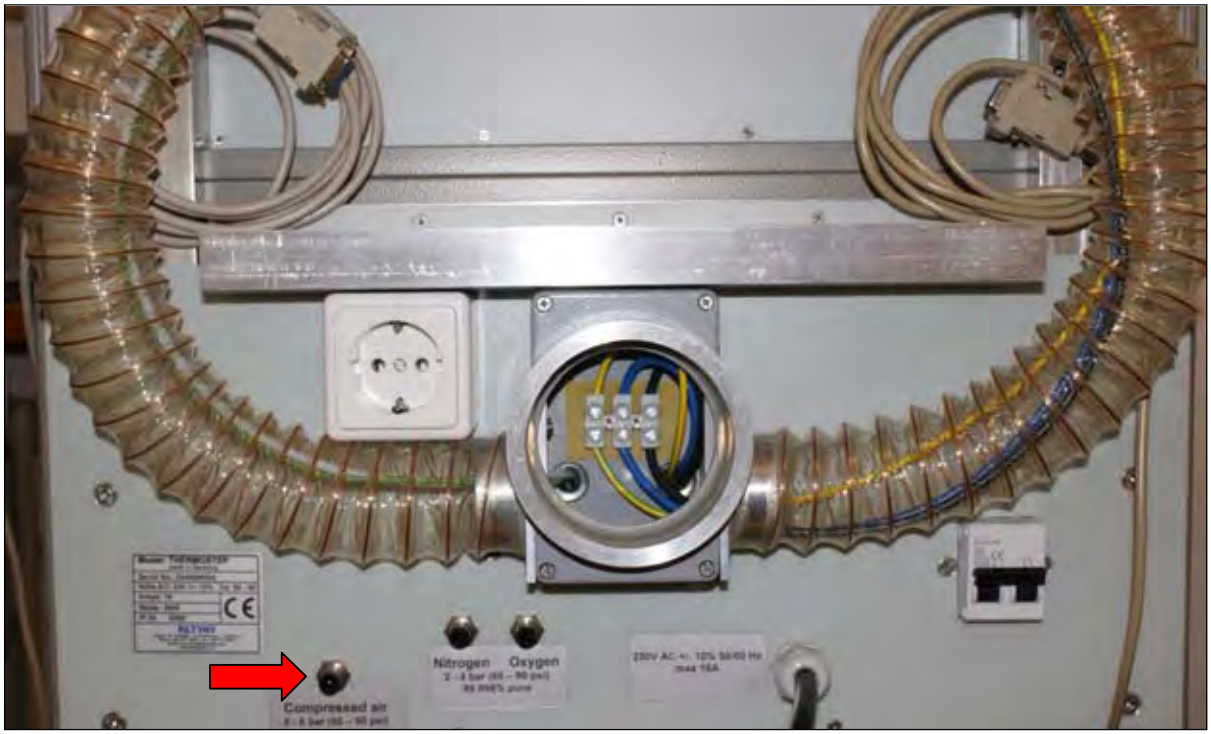


Fig. 2.1: BS – Connector for compressed air

Fig. 2.2: FS – Front with manometers and flowmeter

At b.)
Error message: "No communications! Please check cable, port settings and instrument."

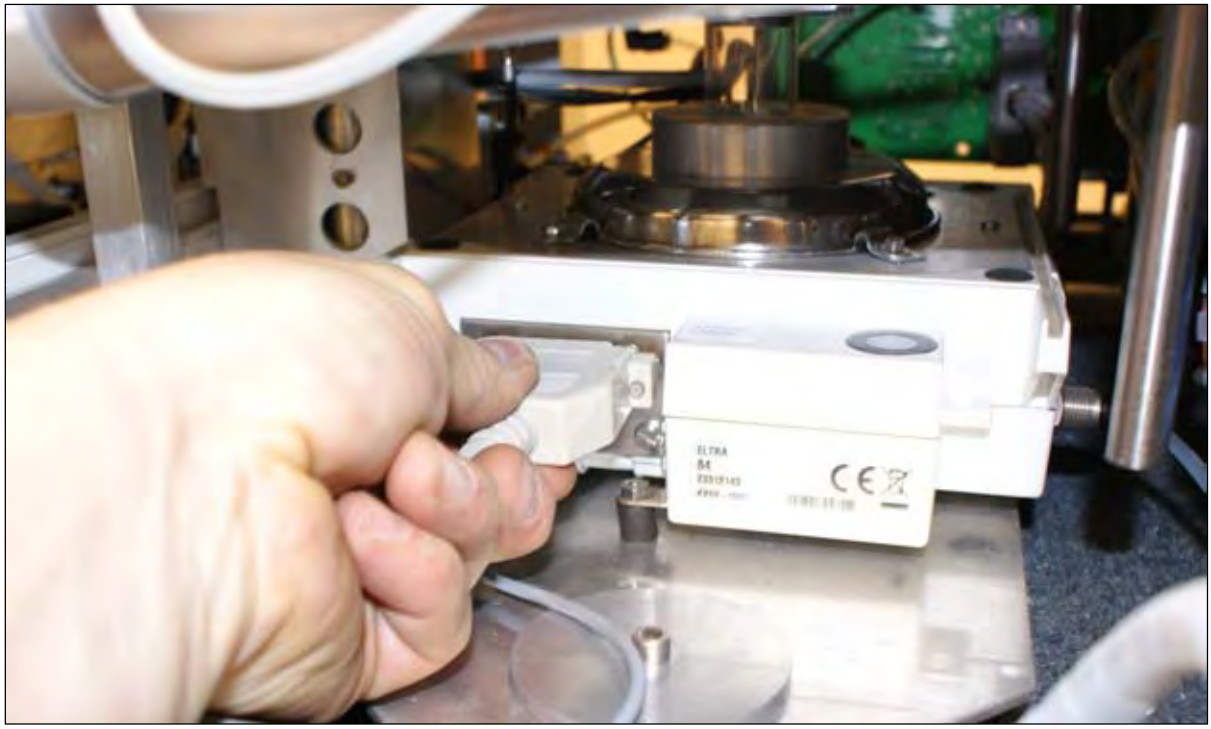


Fig. 2.3: LHS - Balancecable

Check that analyser is switched on and cable connection between Balance and PC (serial port: COM2)! The acces to balance cable is at the LHS.

Check if setting of serial port (COM2) at TGA software is correct (see Operation manual: Form – Login Management).

Check if setting of serial port, where the balance cable is plugged in, at PC hardware is correct.

Check if the balance is switched on! The access to balance display is at the RHS.

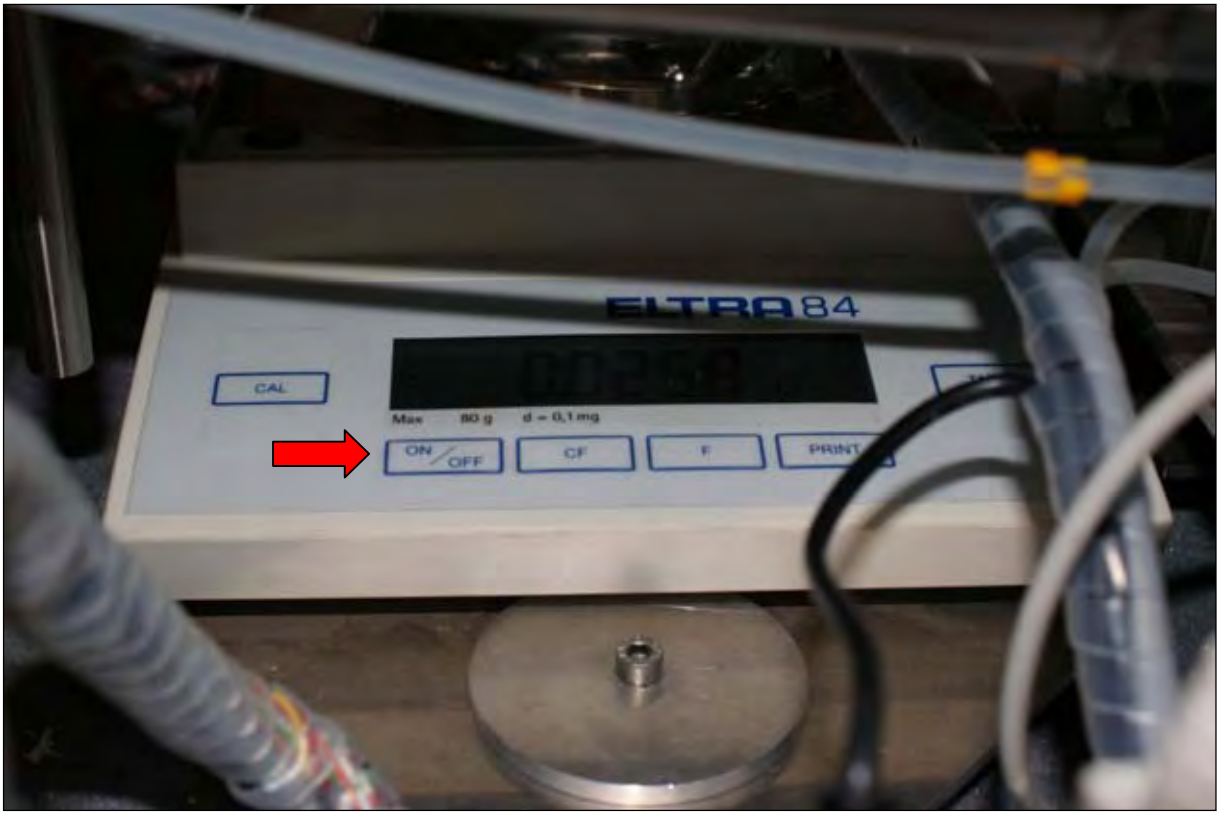


Fig. 2.4: RHS – Balancedisplay and -operationelements

Check if balance is programmed correctly (see **1.6**)!

At c.)
Error message: "Balance doesn't report stable weight!"

Check if balance pedestal is fitted at the extension correctly! Check if extension is mounted inside the analyser correctly.

Remove possible disturbing influences at the balance pedestal!

Tare the balance at the sorftware (see Operation manual: Form – Balance). If this is not possible tare the balance manually via pressing the tare button beside the balance display. The access to balance display is at the RHS. Taring of balance is indicated by an accustic signal and 0.0000 at the display.

Zu d.)
Error message: "No communications! Please check cable, port settings and instrument."

Check cable connection between Analyser (RHS: backside of the board) and PC (serial port: COM1)!

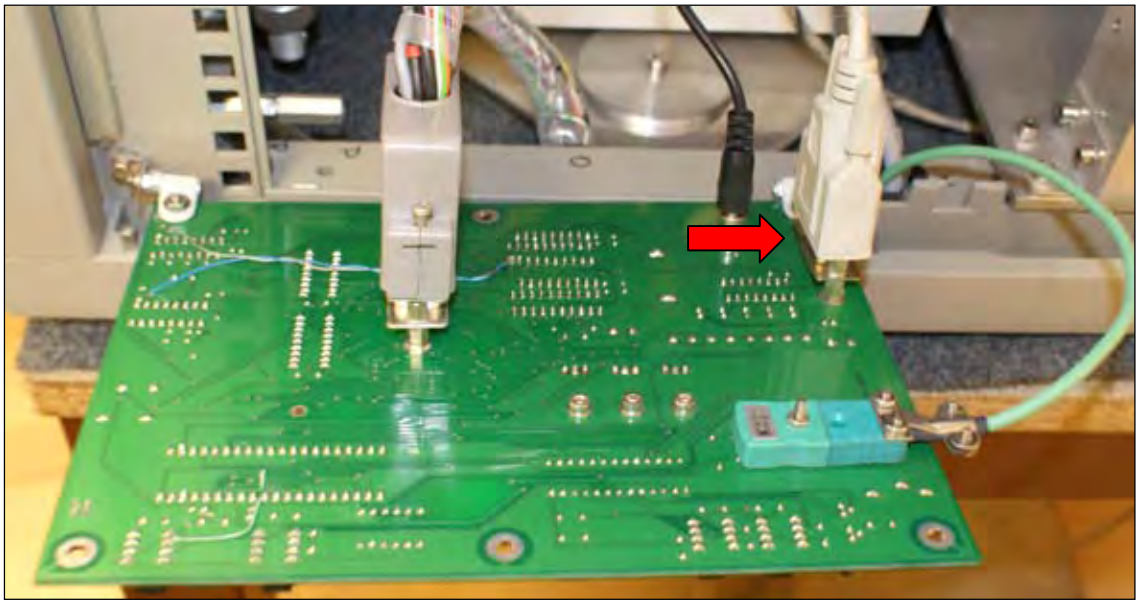


Fig. 2.5: RHS – Connecting cable of board

Check if setting of serial port (COM1) at TGA software is correct (see Operation manual: Form – Login Management).

Check if setting of serial port, where the cable is plugged in, at PC hardware is correct.

At e.)
Error message: "No nitrogen! Please click button [Skip] to continue..." (Message for Oxygen the same).

Check availability of the gases!

This error message appears when no adequate gaspressure is available, as well as there is no gas anymore or the gas supply is closed. You can continue the test manually at this point, but don't forget to check your gas stock before starting the next analysis. Lack of Nitrogen or Oxygen during analysis leads to wrong results or analysis cannot be finished!
Please note that the analyser only checks if the respective gas is available but not if it is available at a sufficient amount! Make assure that your stock is sufficient before starting a new analysis and that the tubes are inserted to the connectors properly.

At f.)
Error message: "Can't setup outputs!"

The below sensors are checked at this point:

Crucible caroussel, Sensor of Purging gas, Lid caroussel
If test is interrupted at this point, check if the sensors a positioned correctly (see **1.2**).

After finishing initialization test sucessfully the cover of the analyser is opened automatically.

2.2 No rotation of caroussel

Error message: "Can't reach needed position!"

An interruption of rotation of caroussel can occur when:

a.) Crucible caroussel is not lifted up
b.) an incorrect position or a defective motorsensor
c.) a defective gear belt
d.) a defective motor

At a.) Condition for rotation of motor is an elevated crucible caroussel to avoid damaging of the balance by lowered crucibles.

Check if gas pressure of compressed air is sufficient (nearly 4 bar). At low gas pressure of compressed air it is not possible to elevate crucible caroussel (see Fig. 2.2).

The same principle is true for an incorrect adjustment of the sensor of crucible caroussel, because the software does not get proper information of status of caroussel. Check if status of caroussel is shown correctly at the software (Form – Controller: **Inputs**) and correct it if necessary (see **1.2**).

Check if it is possible to lift up crucible caroussel manually (see Operation manual; Form – Controller). If this is not possible, despite sufficent gas pressure of compressed air, the respective valve (LHS: 4. valve at the valveblock) or the cylinder of caroussel could be defective (see **3.1** rsp. **3.3**).

At b.) An incorrect adjustment of the motorsensors (see **1.12**) could be reason for this error.

The homesensor is needed for termination of a complete rotation, whereas the movesensor observes the rotation itself. If one of the sensors not correct reply at the software, the motor will be stopped to avoid its overheating.
If the home sensor is not able to detect the encoding screw the motor will be stopped after nearly two full rotations accompanied by an acoustic signal. Is the movesensor not able to detect the rotation of the gear wheel the motor stops before reaching the next crucible position accompanied of an accustic signal.
To check the home- or the movesensor open form – Motor **and** form – Controller. Click at **HOME** and look during rotation if both sensors are activated (Form – Controller: **Inputs**).
Please note: The homesensor is activated only once at every full rotation (near Position 20)!
If one of the sensors does not reply check its functionality first. Bring a magnetizable item (e.g. a screwdriver) next to the sensor and check if now an activation of the sensor is able at the software.
If an activation is possible adjust the sensor position (see **1.12**).
If no activation of the sensor is possible replace the sensor (see **3.15**).

At c.) If the gear belt is defective or loose a rotation of the caroussel is not possible and the motor is switched off to avoid its overheating.

Check the tension of the gear belt from LHS by moving the caroussel manually with the aid of the encoding plate. At proper tension of the gear belt the rotation should be smooth with constant effort. If rotation accompanied with jerky movement the tension of gear belt too loose and has to be retighten (see **3.10**).

At d.) If it is not possible to solve the problem with a.)-c.) it is possible that the motor is defective. At this case it is probably necessary to replace the motor (see **3.10**). Please contact manufacturer.

2.3 Cover doesn't close/open

Error message: "Something wrong with furnace opening!"

Pleae note: If movement of the cover accompanied with jerky movement please read d.)!

This problem could be caused by:

a.) insufficient pressure of compressed air
b.) incorrect adjustment of the sensors for the cover
c.) a defective valve at the valveblock
d.) a defective cylinder
e.) a defective pressure switch

At a.) To move the cover a gas pressure of compressed air of at least 4 bar (better 4,5 – 5 bar) is necessary. Check if gas pressure of compressed air is sufficient (see Fig. 2.2)!

At b.) If the sensors for cover movement are not adjusted correctly, the movement of the cover is possible and takes place, but there is no reply at the software from the respective sensor. So the started movement cannot finished completely.
Movement of the cover is accompanied by an acoustic signal that ends when the sensor reply to software that movement is finished. If one of the sensors is not adjusted correctly the accustic signal don't stops despite the cover is closed or opened completely. Check the respective sensor (cover open up: front sensor; cover closed down: rear sensor) at the cylinder (RHS) and adjust it properly (see **1.15**). The accustic signal stops directly when the sensor reaches its detection area!

Please note: The working procedures described below should be done with cover closed, because a break of compressed air supply can cause a slam of the cover due to its dead weight.

At c.) Check the functionality of the corresponding valve (LHS; 2. valve at the valveblock) and replace it if necessary (see **3.1**)!

At. d.) Check if the tubes are fitted correctly at their connectors at the cylinder (see Fig. 1.11). Listen for sounds that indicates a gas leckage around the cylinder/connectors!
The tube-connectors possesses a coloured ring at their vent. You can remove the tube out off the connector by pressing this coloured ring and pulling out the tube simultanously. Remove the corresponding tube completely out off the connetcor and insert it again.
If the sound appears furthermore the tube-connector can be broken and has to be replaced. The connector can be screwed off the cylinder by a open-end wrench. Afterwards insert the tube again.

A defect of the lid cushioning is indicated by a sound of gas leckage aswell. The lid cushioning is closed by a small screw at the rearward downside of the cylinder (small opening at the rear ring at the cylinder). If there is a leakage at this position, please replace the cylinder (see **3.4**)!

Jerky movements during opening or closing of the lid indicate at a defective cylinder - at correctly adjusted speed of covermovement (see **1.15**)! Try to correct this by changing the speed of movement via the chokes **before** replacing the cylinder (see **3.4**).

At e.) In rare cases the gas pressure switch for compressed air can be defective. The switch checks if the input pressure of compressed air is at least 2 bar and switches on flow. If the pressure is lower than 2 bar the switch doesn't open the tubes and no compressed air is passed into the instrument. The message: "No compressed air availeable !" is shown additionally. Is pressure of compressed air higher than 2 bar and still error then the switch has to be changed.

- Close cover.
- Remove tube of compressed air at the backside of the instrument and check if it is free (see Fig. 2.1).
- Remove the metal sheet with the gas pressure switches carefully at the RHS by unfasten the 3 mm allen screws.

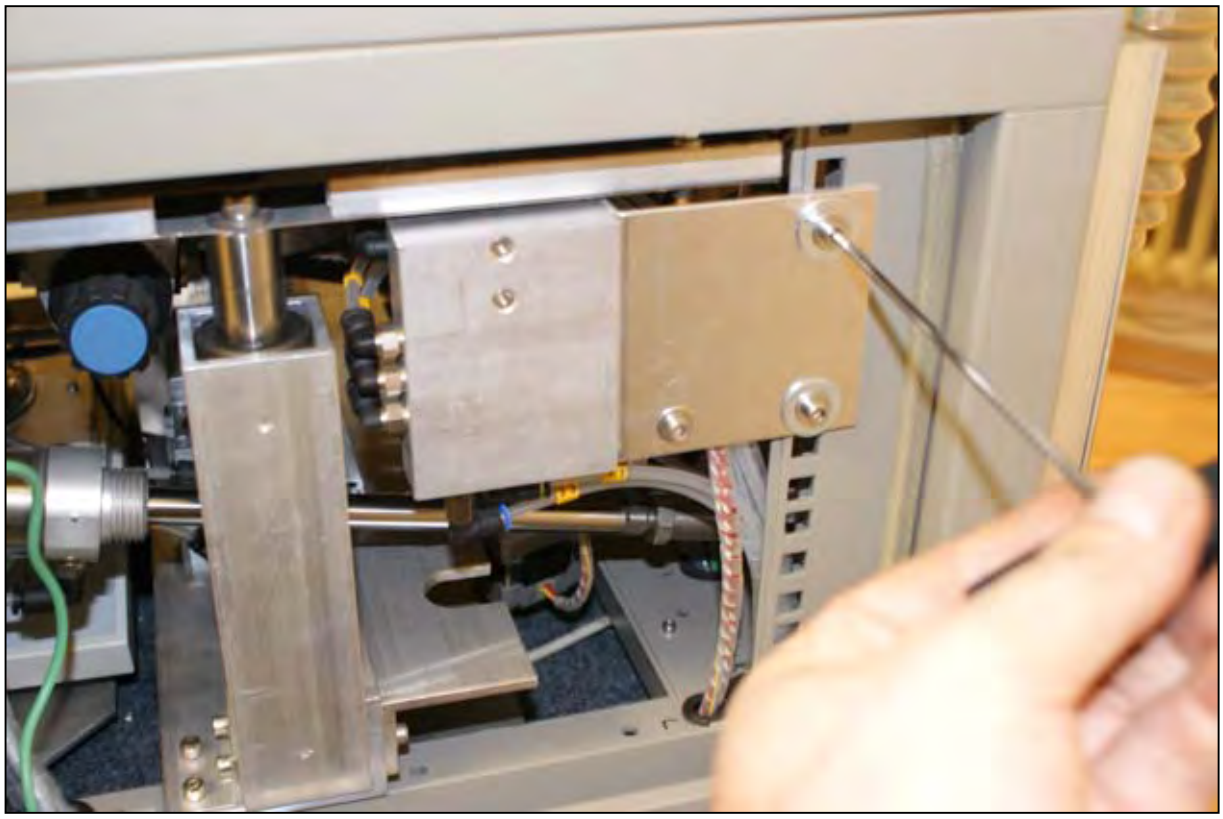


Fig. 2.6: RHS – Metal sheet with Gas pressure switch

- You see the two gas pressure switches (one for compressed air and one for gases), that are covered by a plastic hat. Remove the plastic hat and check the colour of the connected cables.The gas pressure switch is connected by a yellow and a black cable.
- Remove the cables by soldering.
- Remove the switch with an 14 mm open-ended wrench from the metal block. Please note that there is a rubber lip between switch and metal block!
- Replace the switch using the rubber lip.
- Solder the cables at the new switch.
- Replace the plastic hats at the switches and fasten the metal block again.

2.4 Balance unstable

Error message: "Balance is unstable, can't tare!"

An unstability of the balance can be caused by:

a.) strong air movements or vibrations to the instrument from the support table
b.) incorrect adjusted chimney of the balance
c.) incorrect adjusted balance pedestal at the notch of the lower heating element
d.) continuously purging over the balance

At a.) To minimize environmental influences site the Thermostep at a vibration-free, to supply-air protected place. To minimize the influence of air movements keep the lower side panels closed and use the function "**weighing with closed lid**" (see Operation Manual: Form – Configuration). Avoid knocks to the instrument during analysis, not to disturb weighing procedure and to "produce" Junk-crucibles (see **2.6**).

At b.) Check if balance chimney is adjusted correctly (see **1.6**)!

At c.) Check if balance pedestal is adjusted correctly (see **1.6**)!

At d.) It is rarely possible that the unstability of the balance is due to an continuous purging at the balance. At weighing the purging of the balance is switched off to avoid disturbance of the balance pedestal by the purging gas.
A problem with the valve can cause unstability of the balance. Try to switch off purging manually (see Operation Manual: Form – Controller) or to cut the external gas supply. If there is a stabilization of the balance due to one of this points, the contimuous puriging is the reason for the unstability. Please contact the manufacturer of the instrument!

2.5 Crucibles/Lids cannot be discharged/lifted

Error message: "Can't move lids up/down!"
"Can't reach needed position!"

During analysis crucibles are moved to and from the balance pedestal. Afterwards the caroussel is lifted up to site next crucible at the pedestal. For safety reasons a rotation of the caroussel only takes place with lifted up caroussel, because lowered crucibles could damage the pedestal during rotation. At this case the instrument reports unable to reach needed position.
The following reasons can cause this problem:

a.) insufficient pressure of compressed air
b.) incorrect adjustment of the sensors
c.) a defective valve at the valveblock
d.) a defective cylinder
e.) a defective pressure switch

At a.) To lift up/down the caroussels a gas pressure of compressed air of at least 4 bar (better 4,5 – 5 bar) is necessary. Check if gas pressure of compressed air is sufficient (see fig. 2.2)!

At b.) The lifting up and down of the carousels is controlled by sensors, that inspect the actual status of the paricular carousel (**up** or **down**; see Operation Manual: Form - Controller). Check if status is shown properly by software and correct position of sensors if necessary (see **1.2**).

At c.) Check if it is possible to lift up the caroussel manually (see Operation Manual: Form – Contoller). If this is not possible - despite sufficent pressure of compressed air – check the corresponding valve (LHS; 4.valve at the valve block) (see **3.1**).

At d.) If it is not possible to solve the problem by a.) - c.) the cylinder of the corresponding caroussel can be defect and has to be replaced (see **3.3**).

At e.) In rare cases the pressure switch of the compressed air can be defective and has to be replaced (see **2.3e**).

2.6 "Junk"

Error message: "Junk"

If there is an inexactness of sampleweight during analysis (e.g. by a temporarly unstability of the balance or an above-average high loss of weight) the according crucible is marked as "Junk" and listed separately at Form – Results. Software tries to determine the weight of the sample twice, before marking it as "Junk".
Marking a sample as "Junk" should show that there was some unsteadiness but doesn't mean that the resulting data are not useable. The mark should show that there was at least one weighing during analysis at which it was not possible to keep the weight properly respespectivly the loss of weight from one weighing to the next was lot higher than expected. The crucible is analysed despite this marking and the recieved data were shown, so that the operator can use it under reserve.

In rare cases all 20 crucibles are marked as "Junk" and the analysis can not be finished. This error occurs when the crucibles were not sited correctly at the balance pedestal. In most cases the motor calibration is incorrect and has to be checked. Stop analysis for this and open the cover, **after** cooling down, manually (see Operation Manual: Form – Controller).

(Warning: Do not open the Thermostep while the furnace is hot! There is an increased risk of injury by hot pieces inside the furnace!!!)

Check if crucibles are sited properly at the balance pedestal and/or if there are dislocations at the caroussels during lifitng up/down that stop a proper siting of the crucibles. To check this lower and raise the caroussels by sight. In the case of irregularities please contact the manufacturer!

2.7 Stage not finished or prolonged

It can occur that a stage of analysis is prolonged extremely or can not be finished. This can be caused by:

a.) wrong or lacking gas for the corresponding stage of analysis
b.) one ore more of the analyzed samples
c.) a wrong adjusted glass chimney
d.) a wrong temperature
e.) a misarranged or wrong chosen application

At a.) Firstly check the gas reservoir! Please note, that the insturment checks before analysis if there is needed gas available but not in which amount. Please make sure before starting a new analysis that the needed gases are available in sufficient amounts!
Check if the feeding gas pipes are installed correctly at the instrument (see Fig. 2.1). If the gas pipes are interchanged the stages are running at the wrong atmosphere what can cause that chemical reactions not to finish or proceed extremely slow.

At b.) If one analyzed sample has a different chemical consistence than the others (e.g. higher moisture amount) a prolonged stage time is possible. The software completes a stage when **all** samples show the chosen criteria for this stage.
At this case check if the chosen criteria for the stage (see Operation Manual: Form – Application) can be adapted (e.g. other temperature for the stage, wider deviation borders or smaller time span for the stage).

At c.) A wrong adjusted glass chimney changes the atmospheric conditions at the furnace and can be causative for a prolonged stage time. Often this problem is accompanied by increasing and decreasing weights during the stage. (The graph undulates at this case!) Adjust the glass chimney correctly at this case (see **1.6**).

At d.) A wrong chosen or shown furnace temperature can cause a prolonged stage also. Check if the shown temperature agrees to the existing temperature at the furnace by an external temperature determination (see **3.1**).

At e.) The selected application should be adapted at the temperature steps and at the terminal parameters (conditions to terminate a stage) to the analyzed samples. The preinstalled applications of the manufacturer are adapted to the established sample materials for this type of instrument. At the analysis form different materials it can be necessary to determine the optimal temperature steps and deviation borders experimentally and to adapt the application to the respecitve requirements. If required contact the manufacturer for support!
An additional reason can be a wrong chosen application. At this case select the correct application and start a new analysis.

2.8 No Gaspressure, no Oxygen, no Nitrogen

Error message: "No compressed air!"
"No Nitrogen! Please click button [Skip] to continue..."
(Message for Oxygen same!)

The reasons for the message can be:

a.) insufficient pressure of compressed air or empty gas reservoir
b.) interchanged or detached feeding gas pipes
c.) a defective gas pressure switch

At a.) Check if gas pressure of compressed air is sufficient (at least 4 bar) respectivly if there is a sufficient gas reservoir (see Fig. 2.2)!
At b.) Check if the feeding gas pipes are inserted properly at the corresponding tube-connectors at the backside of the instrument (see Fig. 2.1). The tube-connectors possesses a coloured ring at their vent. You can remove the tube out off the connector by pressing this coloured ring and pulling out the tube simultanously. Remove the corresponding tube completely out off the connetcor and insert it at the right position.

At c.) In rare cases the gas pressure switch can be defective and needs to be replaced (see **2.2e**).

2.9 No communication between PC, Analyser and/or Balance

Error message: “No communications! Please check cable, port settings and instrument.”

Check if communication between PC and Thermostep and/or balance is disturbed (indicated by a red spot in front of the respective part at Form – Status, see Operation Manual), firstly.

This can be caused by:

a.) a switched off Thermostep (position 0) or a switched off balance
b.) interchanged or detached cable connections between PC and instrument
c.) incorrect portsettings at TGA software or PC
d.) a defective cable

At a.) Check if instrument is switched at least at position 1 and if it is connected to the electric power supply.
Check at the balance display, if the balance is switched on (see Fig. 2.4). Remove the screw at the left upper edge of the board and hinge it down to get free access to the balance display. If there is nothing visible at the display, switch the balance on by pressing ON. If it is not possible to switch the balance on by this, check if the power supply cable of the balance is inserted properly (see Fig. 2.3).

At b.) Check if the cables of the balance and the board are inserted properly at the right positions at the PC!

Balance cable (Fig. 2.3): serial port COM2
Board cable (Fig. 2.5): serial port COM1

Fasten the cables at their plugs to avoid loosing them inccidently.

At c.) Check if the port settings at the PC and the TGA software are correct!
To check and adjust the allocation of the serial ports at PC read operation manual of the PC.
To check and adjust the allocation of the serial ports at TGA software read operation manual of Thermostep Form – Login Account Management.

At d.) If it is not possible to solve the problem with a.)-c.) check the corresponding cable and replace it if necessary.

2.10 Cover opens at 650°C completely

To shorten up the cooling down phase after the analysis is finished, the cover opens a gap width at 600°C and stays at this position.
A complete opening of the cover at 650°C kann be caused by:

a.) to minor adjustment of the corresponding valve
b.) a defective valve

At a.) Check if the choke at the corresponding valve (LHS; 2. valve at the valveblock) and close it completely (see **1.14**)!

Fig. 2.7: LHS – Choke at the backside of the 2. valve (Cushioning)

At b.) Check the functionality of the valve (LHS; 2. valve at the valveblock) and replace it if necessary (see **3.2**)!

2.11 Cover closes during cooling

If the cover opens a gap width at 650°C but don't remains at this position the instrument tries to bring it at the intended position again.
The reason for the closing of the cover can be:

a.) a defective tube-connector
b.) a defective valve

At a.) Check the feeding gas pipe and the tube-connectors ath the 2. valve at the valveblock (LHS).

At b.) Check the funtionality of the 2. valve at the valveblock and replace it if necessary (see **3.2**).

3. Service

3.1 External Temperature measurement

Required tools: Thermocouple (1,5 mm diameter)
Temperature meter
Notepad

The external temperature measurement is done to control if the shown temperature at the software is equate to the real temperature at the furnace.
For the measurement insert the thermocouple at the device at the upper heating element during analysis. The thermocouple has to be connected with a temperature meter and the temperature inside the furnace can be determined. Variations between shown and measured temperature can be rectified via fuction **Temperaturecalibration** (see Operation Manual: Form – Configuration). At the start of this process the cover of the furnace has to be open.

a.) Note the temperature that is shown under T_{Ref} at Form – Heater.
b.) Open and remove the upper right side panel and the isolation plate behind.

Fig. 3.1.1: RHS – Removed left, upper side panel and isolation plate (red arrow: external thermocouple)

c.) Next to the internal thermocouple there is a small ceramic tube via this the external thermocouple can be inserted to the furnace. Move the thermocouple until visible inside of the furnace (through the ceramic tube) and orientate at the arrangement of the internal thermocouple to get an excat determination as possible.
d.) Start a new analysis.
e.) Check the temperature-course during analysis and note the shown and the determined temperature data at the single stages.
Alternatively the instrument can be heated to the selected setpoint manually to measure the temperature externally.

Fig. 3.1.2: External measurement of furnace temperature during analysis

f.) Calculate the calibration values from the recieved temperature data. Use following formula for the calculation:

$$\mathbf{T_{Set/Det} - T_{Ref} = T}$$

This formula is used for the shown (T_{Set}) and for the determined (T_{Det}) temperature data!

Example:		
	T_{Ref} = 27°C	T_{Ref} = 27°C
	T_{Set} = 105°C	T_{Set} = 750°C
	T_{Det} = 107°C	T_{Det} = 767°C
	105°C – 27°C = 78 (**A**)	750°C – 27°C = 723 (**C**)
	107°C – 27°C = 80 (**B**)	767°C – 27°C = 740 (**D**)

g.) Fill in the determined data at Form – Configuration at **Temperaturecalibration** in the following order: **A**; **B**; **C**; **D**;... (calculated Setpoint; calculated actual value)

h.) Control calibration at the next analysis.

Please remember to use instrument only for external temperature determination without upper right side panel!

3.2 Change of a valve at the manifold

Required tools:
- 4 mm Allenkey
- 8 mm Allenkey
- open-ended wrench
- screwdriver

The manifold at the LHS is build of five single valves, that serve the single components during analysis. The valves connect following components (from frontside of instrument):

Valve 1:	internal blower
Valve 2:	cover
Valve 3:	cushioning of cover
Valve 4:	crucible caroussel
Valve 5:	lid caroussel

The valves are fixed at a metal rail and replaceable individually.

a.) Remove the metal rail from the frame with the 4 mm allenkey.

Fig. 3.2.1: LHS – Removal of the valve block

b.) Hinge down the valveblock carefully out of the instrument. At the backside of the valves are the feeding gas and the power supplies mounted. Furthermore there is a button, that can be used to switch the valve manually.

c.) Check the functionality of the valves and the proper access of the feeding gas pipes. Listen for sounds that indicates a gas leckage and switch the valve via the button manually.

Fig. 3.2.2: LHS – Manual check of valve functionality

d.) In case of a gas leakage remove the corresponding feeding gas tube out of its connector and insert it again.
e.) If it is not possible to correct the gas leckage by this remove the feeding gas tube out of the connector again. Check with the open-ended wrench if the connector is fixed completely.
f.) Replace the connector if necessary.
g.) Is a manual switch of the valve via the button not possible it has to be replaced. Note the orientation of the feeding gas tubes and remove them from their connectors. (By pressing the coloured ring at the vent of the connector you can remove the tube!)

Fig. 3.2.3: LHS – Marking of the tubes

h.) The power supply of the valve is fixed by a screw (transparent header). Unfasten this screw (underside of the valve).

Fig. 3.2.4: LHS – Unfasten the power supply of the valve

i.) Remove the transparent header of the valve. Note the rubber lip!
j.) Unfasten the valve from the metal rail with the help of the 8 mm allen key.

Fig. 3.2.5: LHS - Removal of the valve from the metal rail

k.) Remove the valve. Note the two white washers (one ahead and one behind the metal rail).
l.) Remove the white fitter from the frontside of the valve.
m.) Remove the connectors from the backside if the valve.
n.) Fit the fitter and the connectors to the new valve.
o.) Fix the new valve at the metal rail by using one washer ahead and one washer behind.
p.) Attach the power supply at the new valve and fix it with the screw. Note the rubber seel!
q.) Insert the tubes at the connectors!
r.) Fix the metal rail at the frame.

Note: If you detect a gas leckage after replacing a valve, check if the tubes are fitted properly in their connectors. If this is not the reason for the leckage check if the screw at the metal rail is fasten completely!

3.3 Change of caroussel cylinder

Required tools: 4 mm allen key
5 mm allen key
screw driver

The instrument possesses two caroussel cylinder, one to lift up/down the crucible caroussel and one for the lid caroussel.

Each cylinder has one sensor that reports acutal status of the corresponding caroussel position to the software and two feed pipes for compressed air.

a.) Remove the caroussels out of the furnace to prevent them falling out of their fitting and damaging the inside of the furnace.
b.) Unfasten the screw of the sensor that you can move up and down in its fitting at the cylinder.

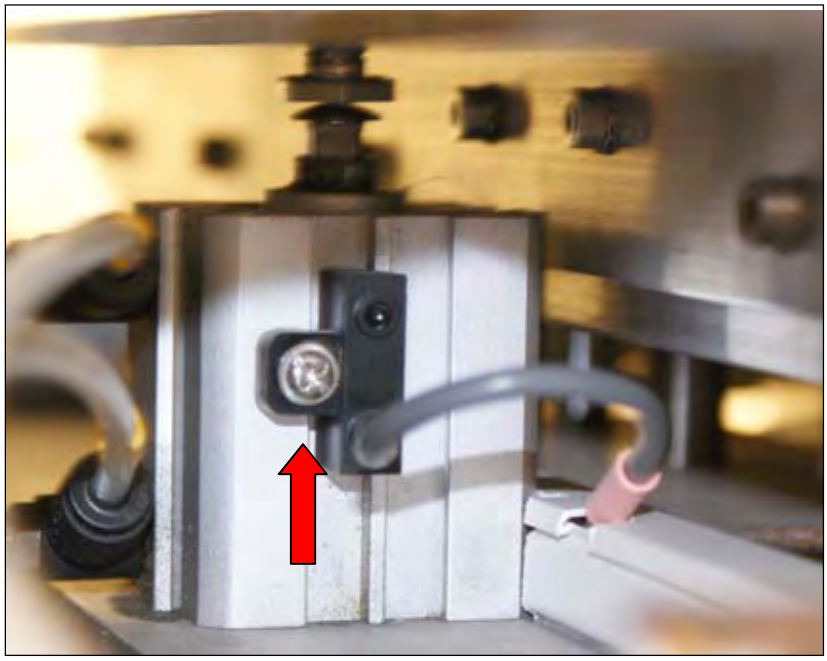


Fig. 3.3.1: Cylinder of caroussell (for removing push sensor in shown direction)

c.) Tipt the instrument to the LHS so you get access to the screws at the underside. Make sure to tipt the instrument of a stable base!
d.) To remove the cylinder of the lidcaroussel unfasten the 2x 4 mm allen screws of the crossbar and remove the cylinder through the upper (RHS) side panel. Detach the feeding gas tubes and remember their orientation by their numbers.
e.) To remove the cylinder of the cruciblecaroussel unfasten the 2x 5 mm allen screws of the crossbar and remove the cylinder through the lower (LHS) side panel. Detach the feeding gas tubes and remind their orientation by their numbers.
f.) Remove the connectors of the cylinder and fit them at the new cylinder.
g.) Fix the new cylinder at the instrument and fasten it with the corresponding screws.
h.) Insert the tubes to the connectors by their original orientation.
i.) Tilt the instrument and fix the sensor at the cylinder.
j.) Adjust the position of sensor and adjust speed of the cylinder (see **1.12**).

3.4 Change of Cover cylinder

Required tools: 2,5 mm allen key
4 mm allen key
snap ring nipper

a.) Remove the sensors from the cylinder by loosen in the 2,5 mm allen screw until you can remove of the sensor out of its fitting.
b.) Remove the fitting.

c.) Remove the gas tubes from their connectors and note their orientation by their numbers.
d.) Unfasten the 2 x 4 mm allen screws at the valveblock of the purging gases that is fitted to the backside of the instrument (RHS). Hinge the valve block out of the instrument.
e.) The cylinder of the cover is fixed with snap rings to its fittings at the front- and rearside of the instrument. Remove this snap rings.
f.) Push the bolts out of the fittings. Note that at the fitting at the frontside there is an additional nut, that can be removed with the bolt. The cylinder is now removeable.
g.) Remove the connectors from the cylinder and fix them at the new cylinder.
h.) Insert the new cylinder to its fittings.
i.) Fix it with the bolts and the snap rings. (Remember the additional nut at the frontside.)
j.) Insert the tubes at the connectors.
k.) Fix the fittings and the sensors at the cylinder.
l.) Adjust correct sensor position (see **1.15**).
m.) Fix the valve block again.

3.5 Change of board

Requried tools: 3 mm allen key
7 mm socket wrench
Screw driver

a.) Unfasten the 5,5 mm hexagonal screw at the upper left edge of the board and hinge it down carefully.

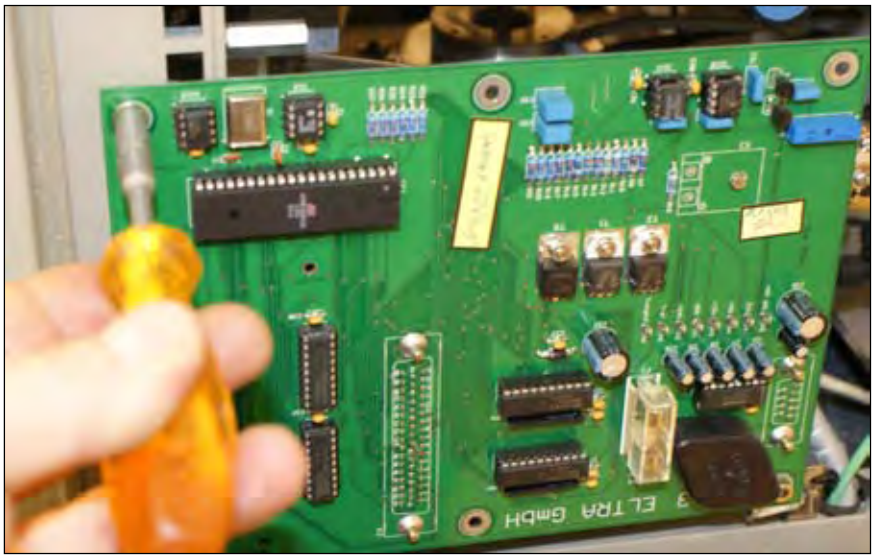


Fig. 3.5.1: RHS – Unfasten of the board to hinge it out

b.) Remove carefully all cables out of their plugs at the backside of the board.

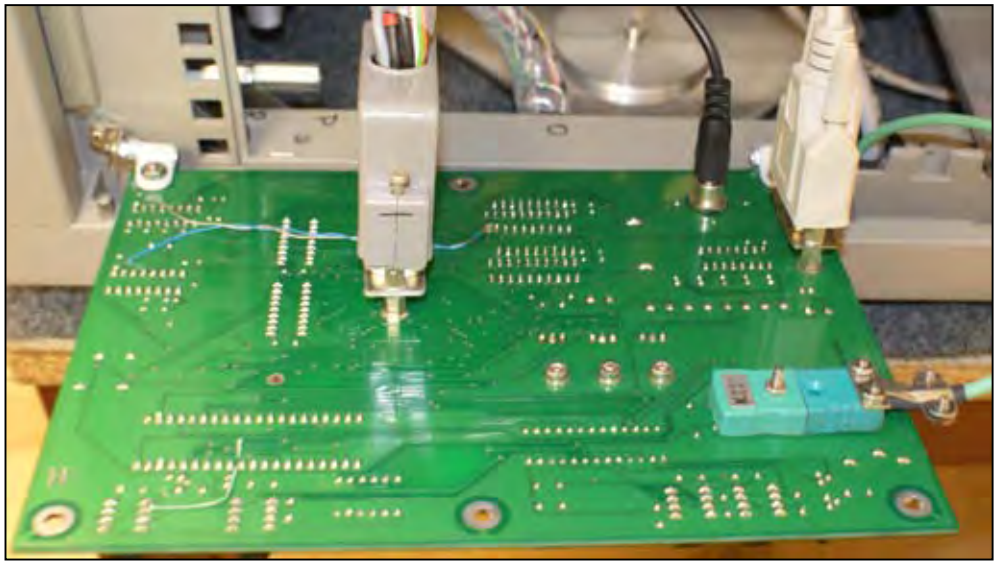


Fig. 3.5.2: RHS – Plugs at the backside of main board

c.) Remove the 2 x 3 mm allen screws from the fittings of the board.

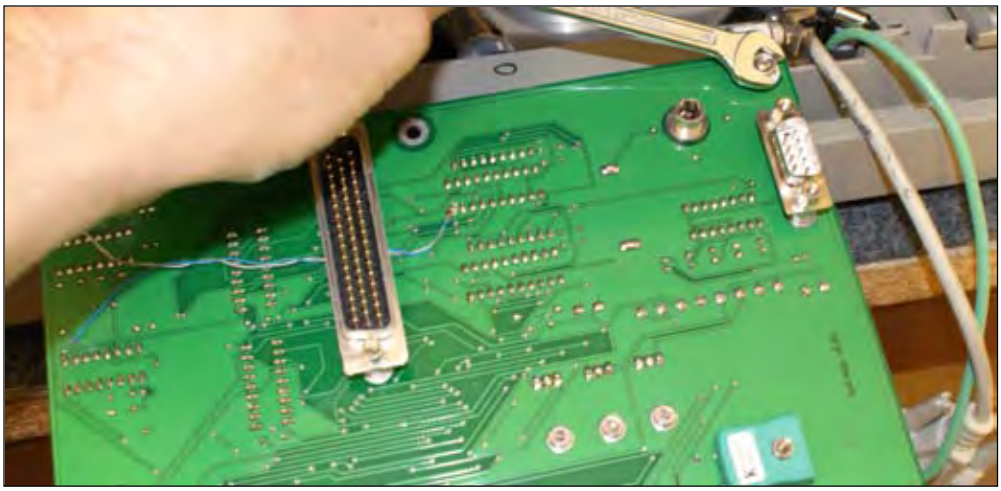


Fig. 3.5.3: RHS – Exchange of mainboard

d.) Remove the board and note its orientation.
e.) Replace the new board at the fittings and fasten it with the the 2 x 3 mm screws. Remind its orientation!
f.) Plug in all cables at the backside of the board and fasten it with the screws if possible.
g.) Raise up the board and fix it again at the upper left edge.

3.6 Change of internal blower

Required tools: 3 mm allen key

a.) Lift the internal blower out of its well manually and put it on the lower metal sheet at the furnace.

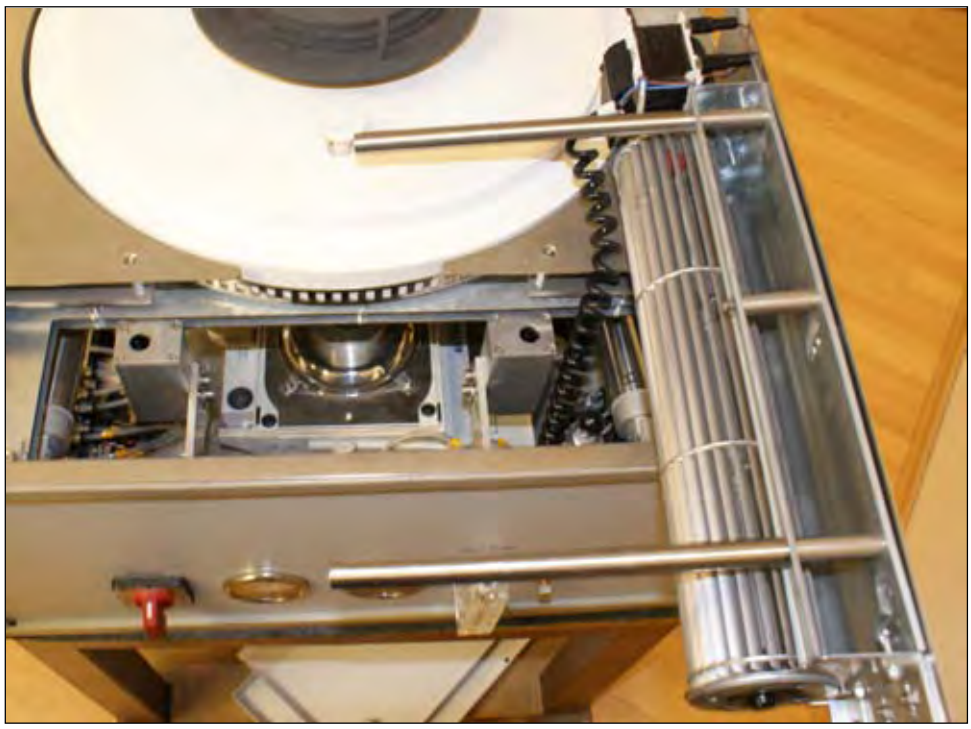


Fig. 3.6.1: FI – Internal blower

b.) Remove the cables from the power supply of internal blower.

Fig. 3.6.2: FI – Power supply of internal blower

c.) Connect cables of the new blower with power supply.
d.) Remove cover of the removed blower.

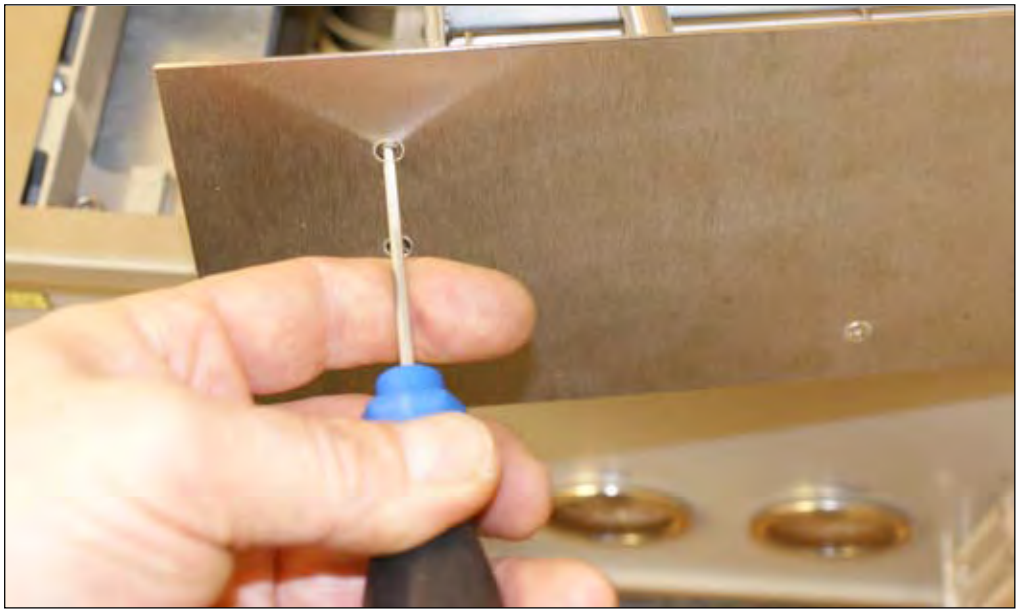


Fig. 3.6.3: FI – Cover of internal blower

e.) Fix the metal plate at the new blower so that the blower can be lowered without contact to the lower metal plate inside the furnace.
f.) Put the new blower to its well and test its functionality.

3.7 Change of cylinder of internal blower

Required tools: 8 mm open-ended wrench

a.) Unfasten the 4 x 8 mm screws that fasten the front metal plate.

Fig. 3.7.1: LHS/RHS – Unfasten of front metal plate

b.) Hinge out the front metal plate to get free access to the cylinder of the internal blower.

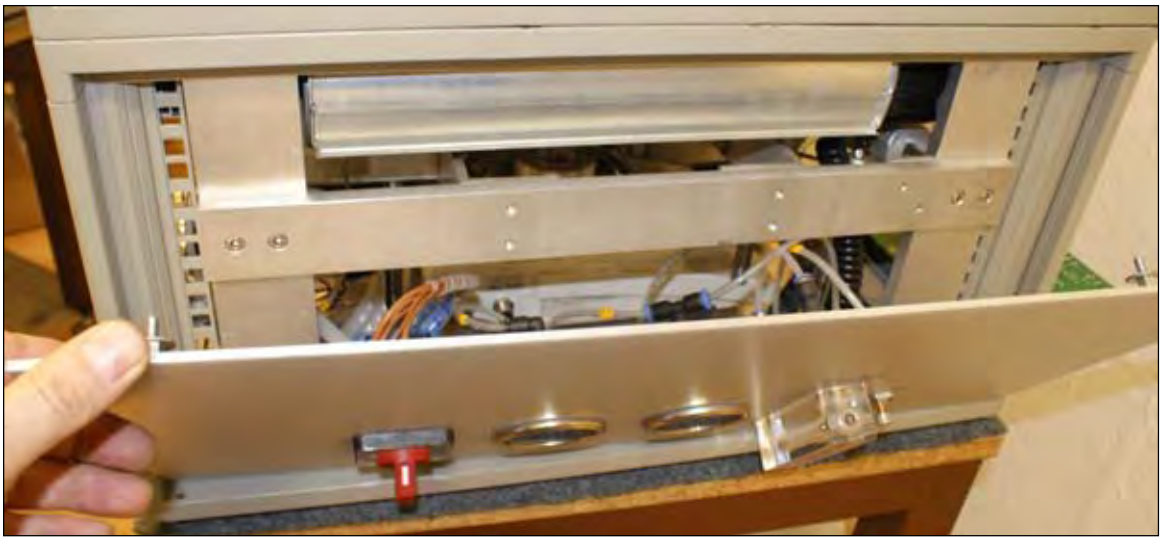


Fig. 3.7.2: FS – Hinge out front metal plate

c.) Unfasten the screw that fixes the cylinder at the instrument and remove the cylinder.

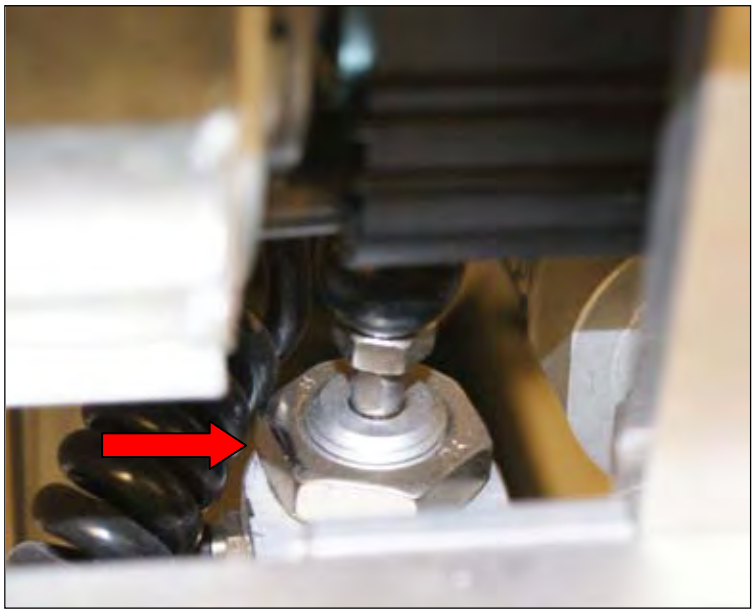


Fig. 3.7.3: FS – Screw of cylinder of internal blower

d.) Insert the new cylinder and fix it.
e.) Close the front metal plate again.

3.8 Change of balance

Required tools: 4 mm Allen Key
5.5 mm Nut Driver (short)
15 cm length of Heavy Duty Cardboard Tube (for lid support)
Small Phillips Screwdriver (for data plug)

Unplug instrument from electrical supply and disconnect the compressed air supply.

a.) Prop up lid using a section of heavy duty cardboard tube under the LHS pneumatic ram arm.

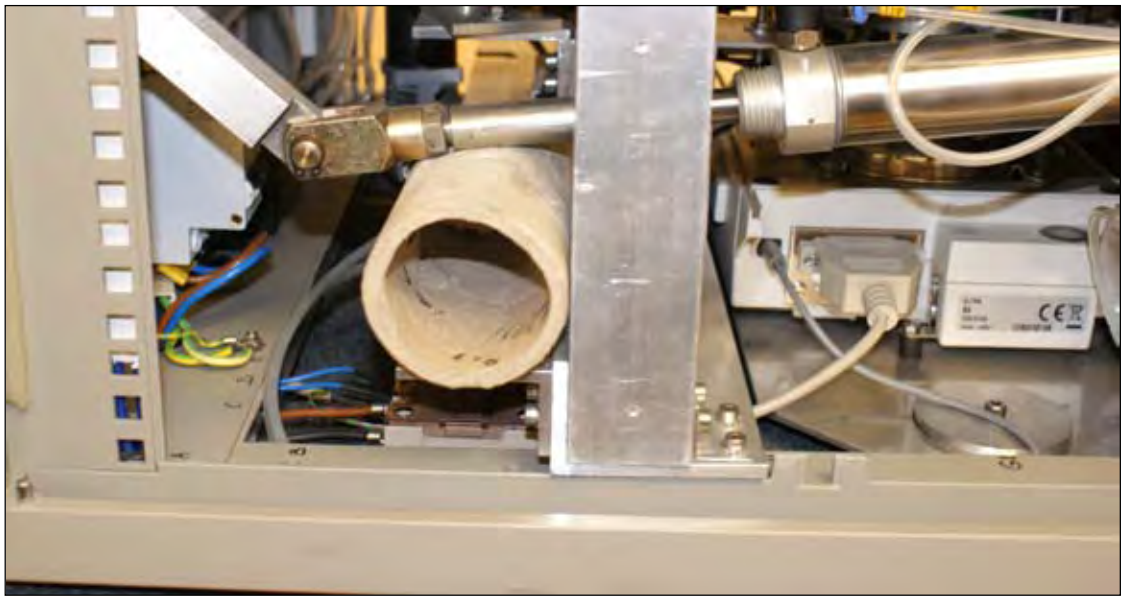


Fig. 3.8.1: Prop up cover using heavy cardbord tube

b.) Lift out balance pedestal and ceramic tube from the balance.

Fig. 3.8.2: FI – Lift out balance pedestal

c.) Unscrew manifold on the LHS and hinge it out of the instrument carefully.

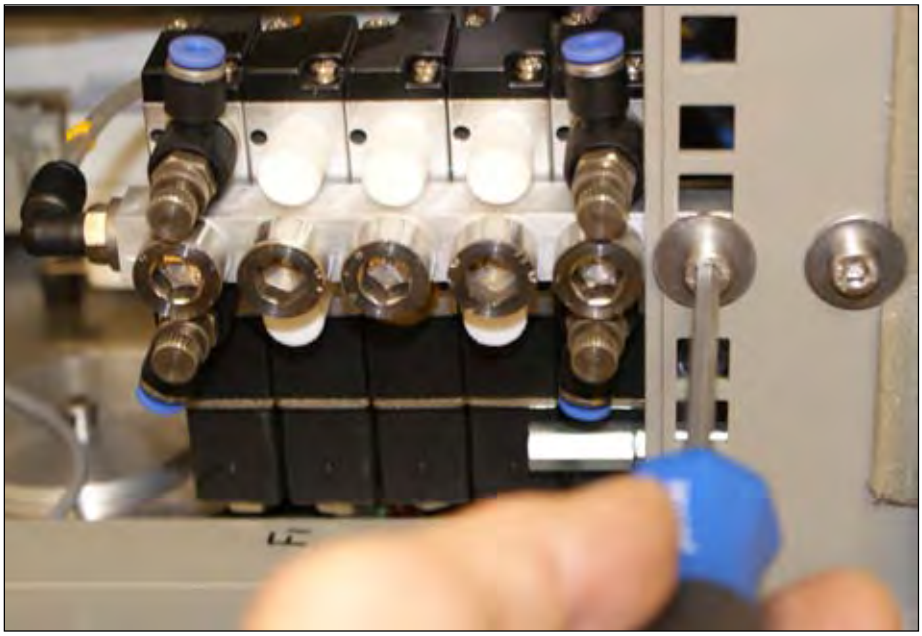


Fig. 3.8.3: LHS – Unscrew manifold

d.) On the LHS of the instrument disconnect the data cable, and power supply plug from the back of the balance.

Fig. 3.8.4: LHS – Unplugging balance cable

e.) On the RHS remove the 5.5mm nut which secures the TGA 1.2 pcb and hinge the board down to improve access to the balance (see Fig. 1.6).

f.) Disconnect the balance purge tube (No.27) from the side of the balance

Fig. 3.8.5: LHS – Disconnecting purge tube of the balance

g.) From the LHS undo the wing nut which secures the wind shield glass tube. Allow glass tube to slide down and rest on the balance shield (see Fig. 1.5).

h.) Using a small 5.5mm nut driver loosen the four 5.5mm nuts holding the clamps that secure the balance shield to the balance. Turn each clamp 90 degrees and from the LHS carefully lift off the balance shield and wind shield.

i.) Remove completely 2 x 4mm allen screws and 2 x aluminum disc from the front and rear of the balance base plate.

Fig. 3.8.6: LHS/RHS – Loosen the balance shield

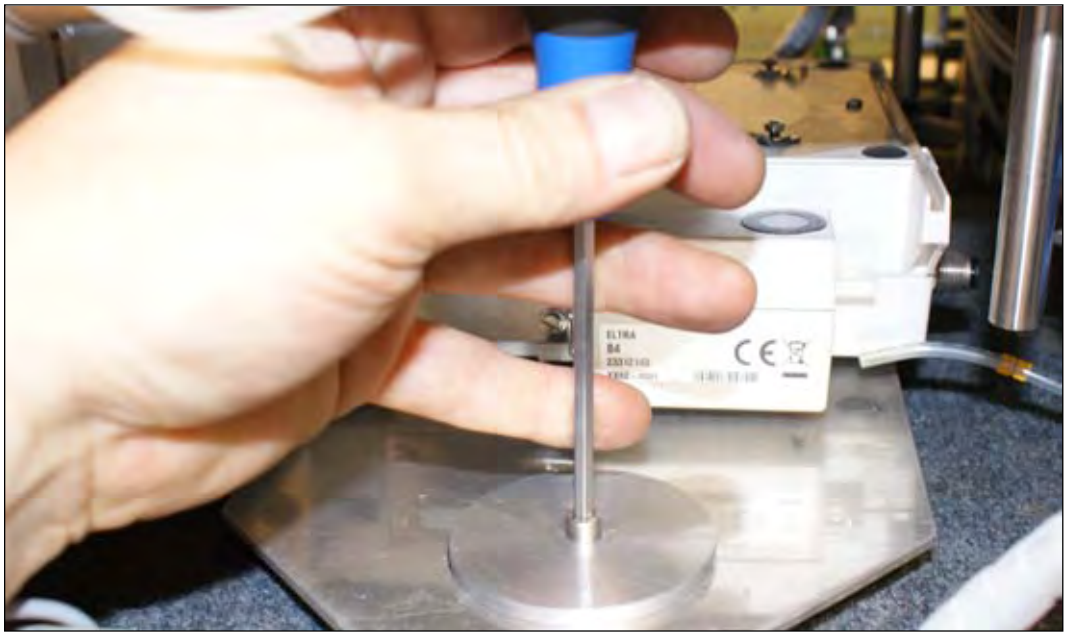


Fig. 3.8.7: LHS – Unscrew balance base plate

j.) Carefully slide out the balance and base plate from the LHS of the instrument taking care not to knock the balance spigot on the pneumatic ram.

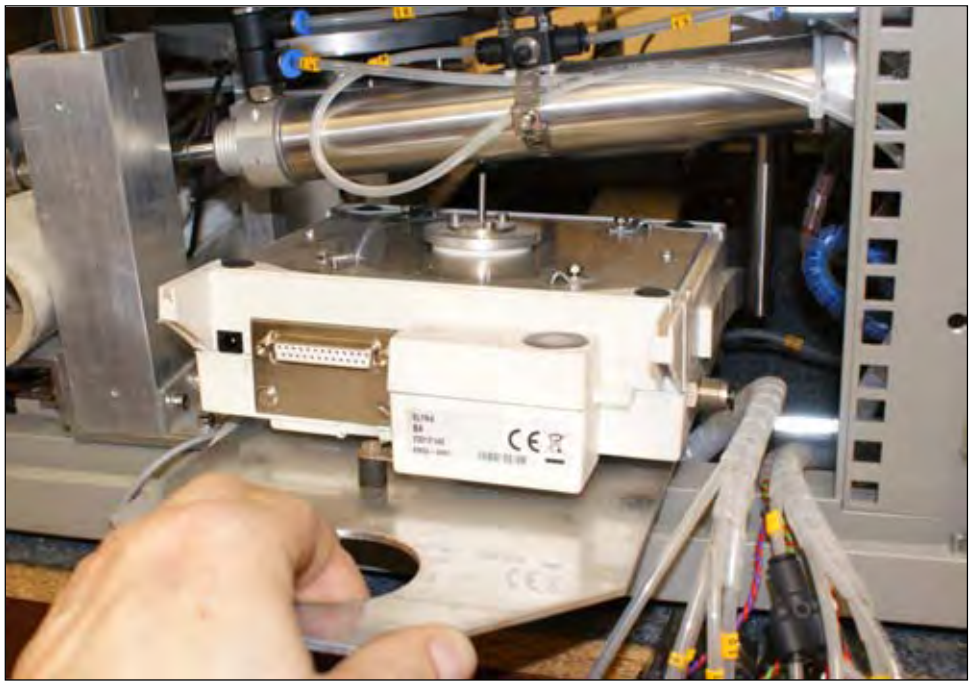


Fig. 3.8.8: LHS - Sliding out of balance with base plate

If installing a new balance fit it to the base plate.
The balance communications settings are as follows:

911	Reset
114	Stable
517	9600 Baud Rate
613	Auto Sense Stability

To install the balance reverse the above procedure.
Check that the balance is level by using a dental mirror to view the bubble gauge at the back of the balance. Adjust the front legs of the balance to get the bubble in the middle of the circle. Once this is complete loosen the 2 x 4mm allen screw which secure the balance base plate to the instrument frame and gently slide to align the balance pedestal central to the hole in the lower furnace. Check also that the base plate is aligned and square to the frame. Tighten the base plate allen screws to secure balance in this position. Place a crucible in the carousel and check for correct alignment and clearance. Adjust as required to finalise this procedure.

3.9 Change of Thermocouple

Required tools: 3 mm allen key
Screw driver

a.) Lift out the plastic buttons from the 4 x 4mm csk allen screws in the top cover of the lid. Remove 4 x 4mm csk allen screws and lift off top cover.

Fig. 3.9.1: TS – Unscrew top of cover

b.) The thermocouple connects to the socket mounted at the rear inside the lid. Disconnect the cable from the plug.

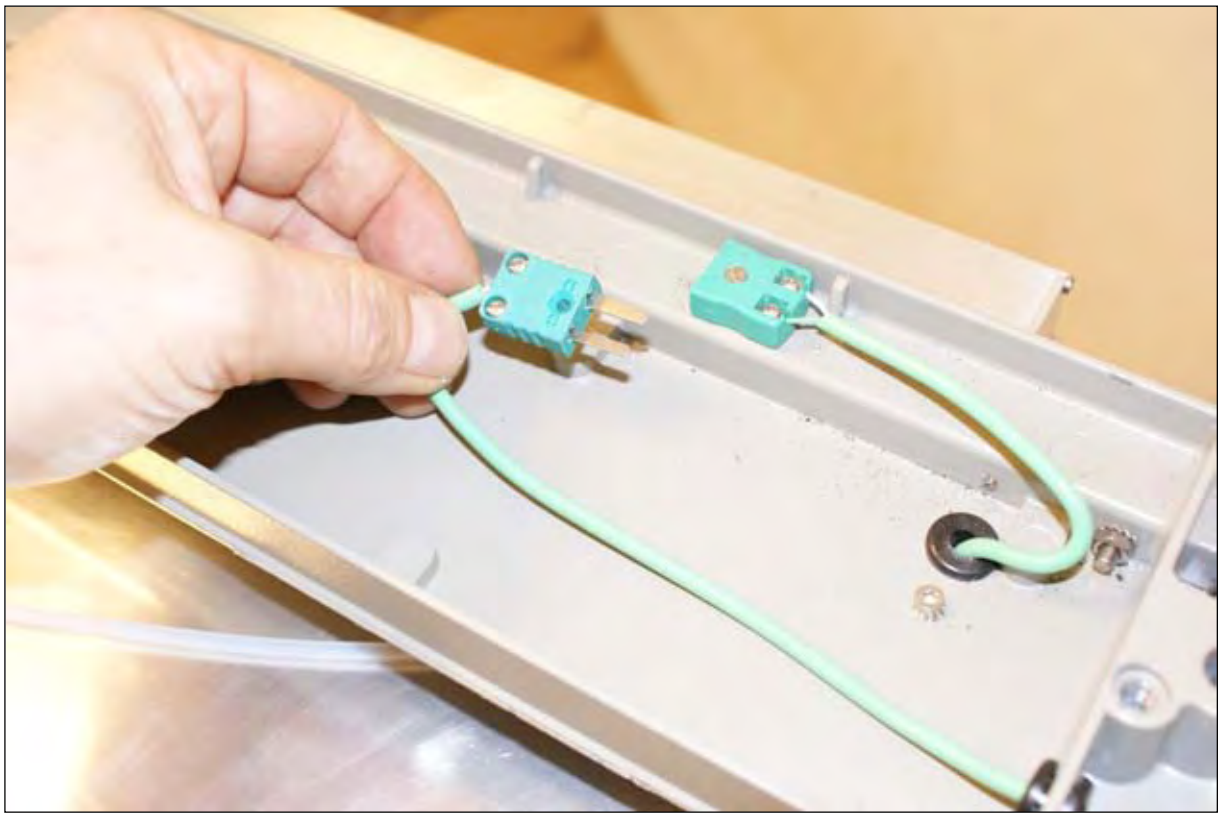


Fig. 3.9.2: TS – Unplugging of Thermocouple

c.) Unfasten the screws of the socket. Disconnect the two wires from the socket (green is +ve).

Fig. 3.9.3: TS – Disconnecting cable from the plug

d.) Remove upper right side panel.
e.) Unfasten the 4 x 3 mm allen screws and remove the isolation metal plate behind.

Fig. 3.9.4: RHS – Unscrewing isolation plate

f.) Pull the wire through the rubber grommets along the frame and remove the fitting between rubber grommets to get free access to the cable.

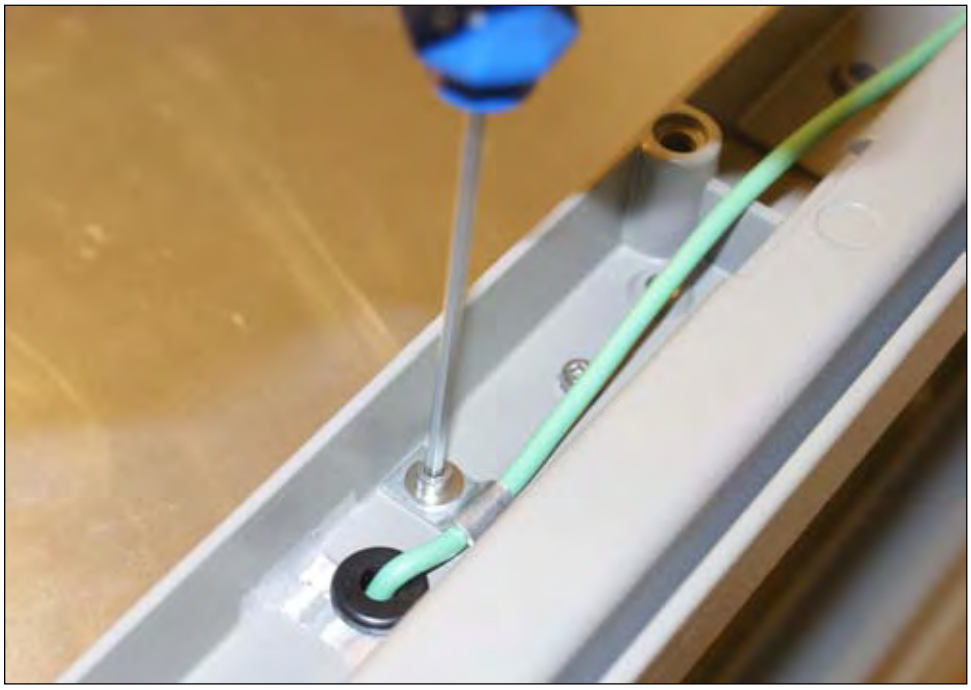


Fig. 3.9.5: TS – Unscrewing fitting of Thermocouple cable

g.) Remove the thermocouple out off the ceramic device.

Fig. 3.9.6:: RHS – Removing of the Thermocouple out of the ceramic tube

h.) Insert the cable of the new thermocouple through the rubber grommets along the frame and fix it with the fitting.
i.) Fasten the wires at the socket and remind their orientation. Plug in the socket.
j.) Push the thermocouple carefully till the bottomed in the ceramic device.
k.) Close the upper right isolation metal plate and side panel.
l.) Close the top cover again.

3.10 Change of Motor

Required tools: 1.5 mm Allen Key
2.5 mm Allen Key
4 mm Allen Key
8 mm open-ended wrench

a.) On the RHS unscrew the 2 x 4mm allen screws securing the purge valve module to gain better access to the motor.

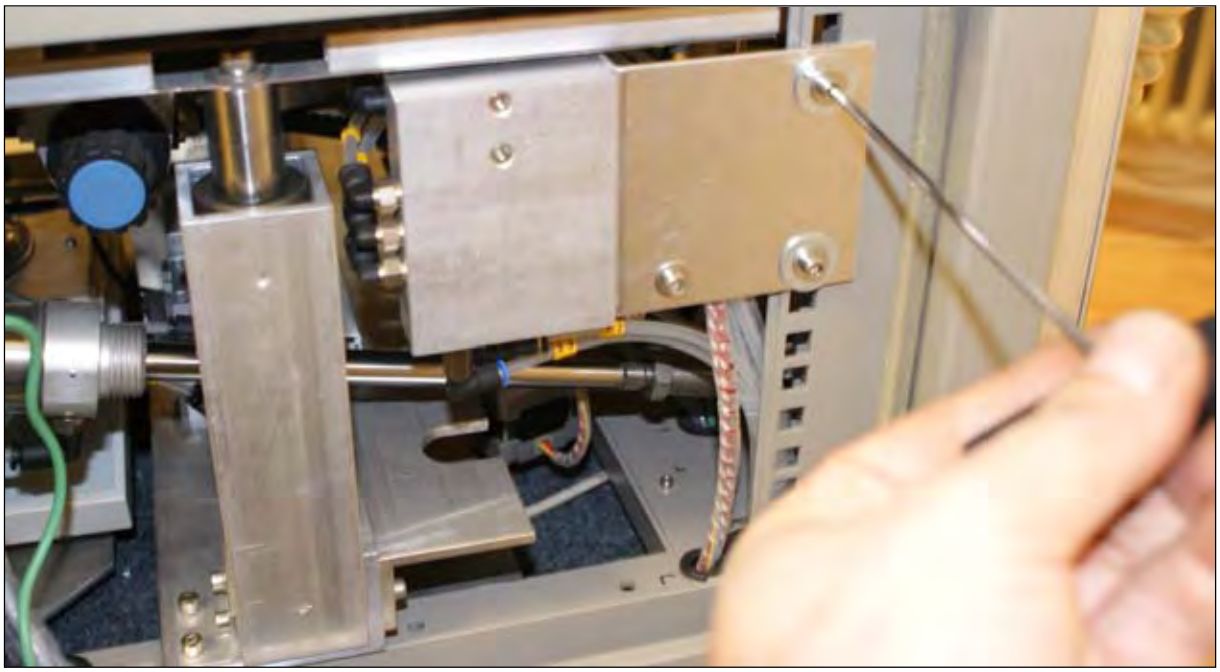


Fig. 3.10.1: RHS – Unscrewing purge valve module

b.) On the LHS undo the 8mm nut and 4mm allen screw securing the motor mount bracket.

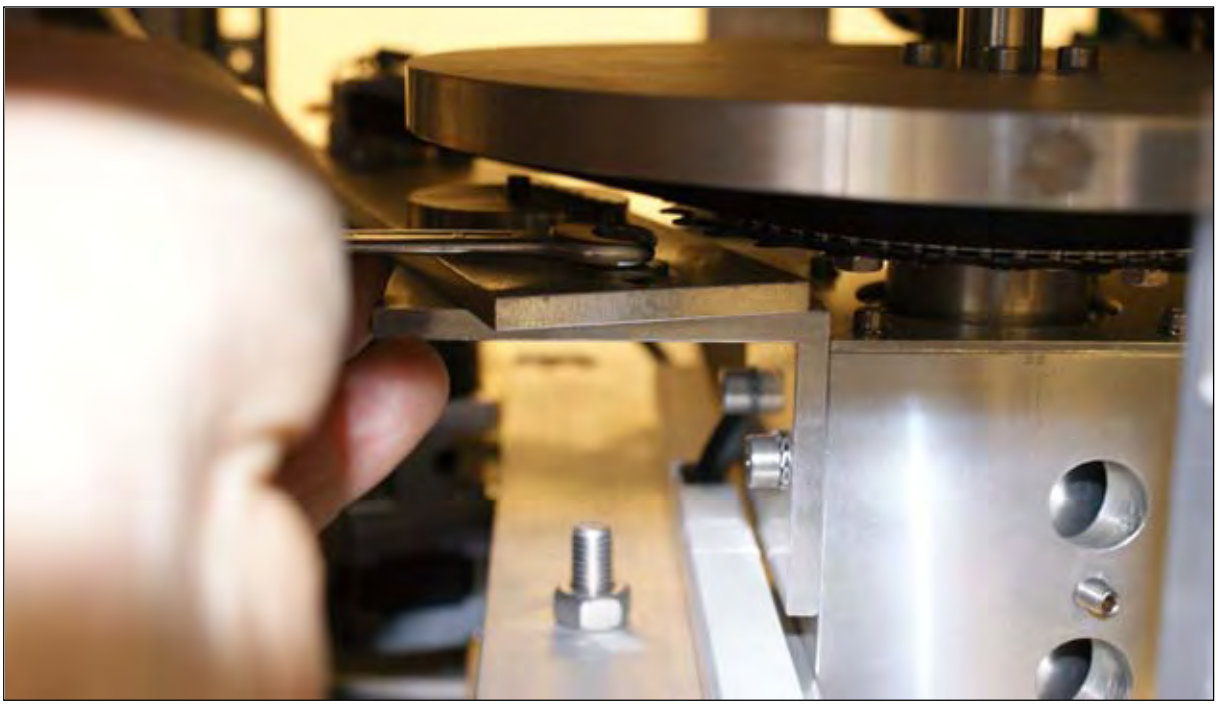


Fig. 3.10.2: LHS – Loosing the motor mount bracket

c.) Slip the belt off the drive wheel and access motor from the RHS.

d.) Unplug the motor (white plug) and remove the drive wheel from the shaft 2 x 1.5mm allen screws.

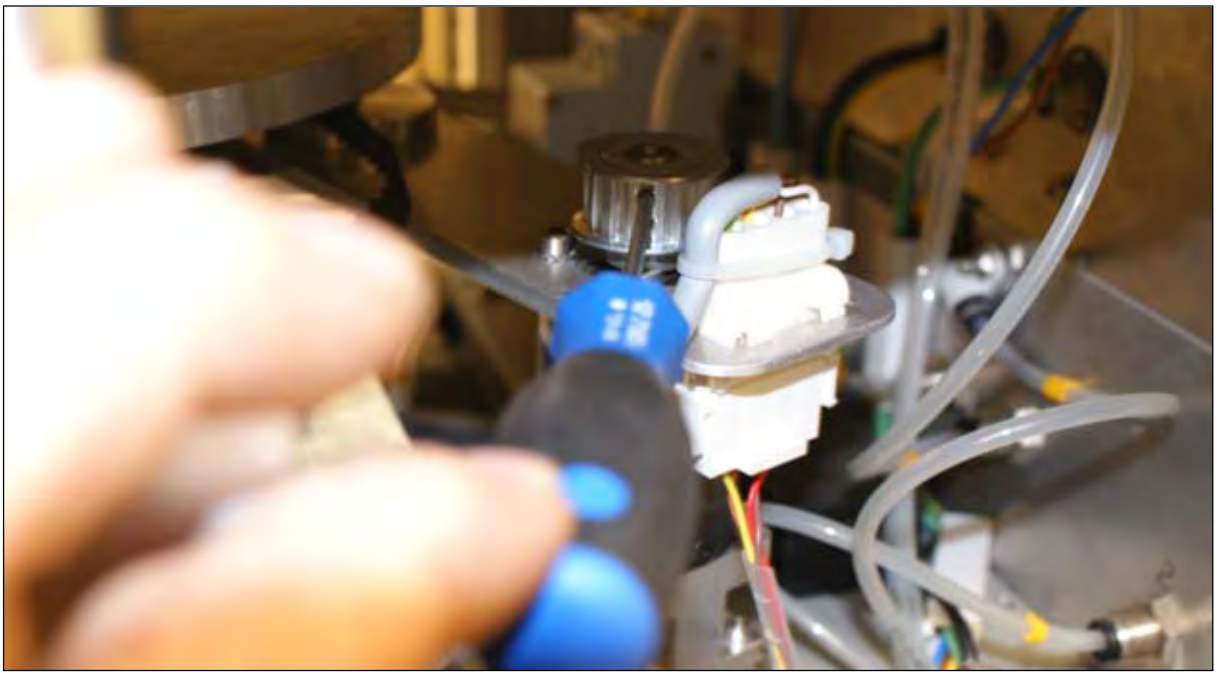


Fig. 3.10.3: RHS – Unscrewing drive wheel from the shaft

e.) Undo the 4 x 2.5mm allen screws holding the motor and gearbox to the motor mount.

Fig. 3.10.4: RHS – Unscrewing the screws holding the motor

Reverse this procedure to fit the motor. Tension the belt so that there is about 1cm flex when each side is squeezed. Take care to ensure that the lift mechanism is clear of the motor mounting when raised and lowered.

To change the drive belt undo the 4 x 2.5 mm allen screws securing the carousel shaft and lift out carousel. Reduce tension in the belt by loosening the 8mm nut and the 4mm allen screw which secure the motor mounting plate. Lift off the belt and replace with a new one. Re-tension the belt, replace carousel and set up the home position as described in the Lower Furnace Procedure.

General Information

Carousel Motor Drive Gearbox
The Thermostep motor gearbox has a 40:1 ratio.
The Thermostep carousel rotates in a clockwise direction and has 1600 steps between each crucible position.

3.11 Change of Power supply

Required tools: 5,5 mm allen key
Soldering tools

a.) Remove the caroussels of the furnace to prevent them falling out of their fitting and damaging the inside of the furnace.
b.) Tilt the instrument to the LHS that you get access to the screws at the underside. Make sure to tilt the instrument to a stable base!
c.) Unfasten the 2 x 5,5 mm allen screws at the rear metal plate.
d.) The power supply is covered by tubes, move them carefully aside to get free access.
e.) The power supply is connected with two cables, one plugged-in and one hard-wired. Plug off the one cable.
f.) Trim the hard-wired cable through at appropriate lengh.
g.) Remove the insulation of the cable and prepare the strands for soldering.

h.) Prepare the cable of the new power supply for soldering aswell.
i.) Solder the cable of the new power supply to the one at the instrument at the right orientation.
j.) Plug in the cable to the new power supply.
k.) Fasten the new power supply at the instrument.
Please note: The screws have a definite lenght. If you have to substitute one of the original screws make sure to get the same lenght to prevent damaging the new power supply.

3.12 Change of flowmeter, choke, manometer

Required tools: 8 mm open-ended wrench

a.) Unfasten the 4 x 8 mm screws that fix the front metal plate to the instrument. (see Fig. 2.2)
b.) Hinge down the front metal plate to get free access to the gauges.
c.) Remove the tubes of the respective gauge.
d.) Unfasten the gauge out off its fitting.
e.) Replace the gauge and fix the new one.
f.) Insert the tube to the new gauge.
g.) Close front metal plate again.

3.13 Change of a sensor

In general the replacement of the sensors works the same way. The difference between the sensors is the form and according to this their fitting at the instrument.
The motor sensors are fixed with nuts (8mm), the caroussel sensors are fastened with screws at their cylinders and the sensors for the cover are fixed by clamps at the cylinder.

a.) Unfasten the sensor off its fitting.
b.) Cut the sensor wire in an appropriate lenght and remove the insulation!
c.) Solder in a new also prepared sensor. Remember the right orientation!
d.) Insulate with the appropriate heat shrink tubing and fix it at its fitting.
e.) Adjust the sensor position and fasten it again.
f.) Check correct functionality of the new sensor.

3.14 Removal of lower heating element

Unplug instrument from electrical supply and disconnect the compressed air supply

Required tools: 2 mm Allen Key
2.5 mm Allen Key
4 mm Allen Key
5 mm Allen Key
15 cm length of Heavy Duty Cardboard Tube (for lid support)

k.) Prop up lid using a section of heavy duty cardboard tube under the LHS pneumatic ram arm (see Fig. 3.17).
l.) Lift off carousels and lift out centre shaft used to lift the lids.
m.) Remove 6 x 2 mm and 2 x 2,5 mm csk allen screws securing the stainless steel (s/s) furnace surround (see Fig. 1.3).

n.) Carefully lift out balance pedestal (see Fig. 3.18).

o.) Rotate carousel shaft to expose two of the four 2.5mm allen screws securing the carousel shaft. Loosen the screws. Continue to rotate the shaft to expose the remaining 2 x 2.5mm screws. Loosen these screws and then lift out the carousel shaft (see Fig. 1.2).

p.) Disconnect the furnace wires from the two electrical terminals (5mm allen screws) at the rear side of the instrument.

q.) Loosen the 5mm allen screw on the s/s strap around the furnace and carefully lift off, avoiding the electrical wires at the rear of the furnace.

r.) Loosen the 2 x 2.5mm allen screws securing each of the front two positioning supports and slide them forward to free the furnace.

s.) Lift out lower furnace assembly.

3.15 Replace the Lower Furnace in the Thermostep TGA

Unplug instrument from electrical supply and disconnect the compressed air supply.
Assuming the lid is in the propped up position.

a.) Lower new lower furnace into the TGA frame and slide it backwards to rest against the rear positioning supports.

b.) Align the centre shaft hole and the balance pedestal hole the balance spigot and centre drive shaft and ensure that the furnace is centralized.

c.) Place the s/s furnace strap back into the frame and check the height of the furnace. The lower lip of the furnace should be at the same height as the s/s surround. There are three height adjustable furnace supports under the furnace that can be adjusted to achieve this important stage.

d.) Check also, once the furnace is at the correct height and aligned that there is an even 4mm gap between the s/s surround and the furnace.

e.) Once the furnace is aligned correctly slide the the two front positioning support towards the furnace and tighten the 2 x 2.5 mm allen screws.

f.) Place the s/s strap over the lower furnace and position the adjustable clamp screw mechanism adjacent to the RHS front positioning support. Tighten the 5mm allen screw to secure the furnace in position. **Recheck alignment.**

g.) Connect the furnace and supply cables to the terminal posts at the rear of the furnace. Ensure that the wires from the furnace are pushed down so that there is no possibility of them coming into contact with any metal surround or frame above or below. Also ensure that the supply cables are clear of the hot surfaces of the furnace and cannot be trapped in the lid mechanism.

h.) Replace and secure s/s surround with 6 x 2.5mm csk allen screws.

i.) Lower carousel shaft into the centre hole. Place carousel on to the four support pins in the shaft. Position the carousel so that the first slit in the carousel to the left of one of the support pins is directly above and central over the balance pedestal hole.

j.) With carousel in this position rotate the motor drive to expose two of the four shaft securing screws located below the furnace. Tighten these screws. Rotate the carousel to expose the other two securing screws and tighten.

k.) Now rotate the carousel so that the home sensor screw in aluminum wheel is directly opposite the home sensor. Check the carousel is now aligned with the slot on the RHS of any one of the support pins. This will be the home position and

should be exactly between position 1 and position 20 on the carousel. Check and align as required.

l.) Insert the ceramic balance pedestal tube, align on the balance spigot and gently push down to locate securely. Rotate to align centrally. Place pedestal on the ceramic tube and check for even clearance all around.

m.) Adjust software steps to align carousel so that position 1 is directly over the balance pedestal.

General Information

Thermostep Furnace Information

Each element in the heater of the Thermostep (two in the upper furnace and one in the lower furnace) has an impedance of 39 ohms.

All the three elements (two in the upper furnace, one in the lower furnace) are connected in parallel which gives a total impedance of 13 ohms.

The maximum current draw for the heaters is 17 amps.

The maximum power is 4080 watts.

3.16 Removal of upper heating element

Unplug instrument from electrical supply and disconnect the compressed air supply

Required tools:
- 2 mm Allen Key
- 2.5 mm Allen Key
- 3 mm Allen Key
- 4 mm Allen Key
- 5 mm Allen Key
- 13 mm Socket and Wrench

a.) Remove upper LHS & RHS panels by unscrewing the plastic coated Phillips screws. These should only be finger tight.

b.) Remove LHS & RHS aluminum insulation panels (4 x 3mm allen screws in each panel – see Fig. 3.9.4 – Page 49).

c.) Lift out the plastic buttons from the 4 x 4mm csk allen screws in the top cover of the lid. Remove 4 x 4mm csk allen screws and lift off top cover (see Fig. 3.9.1 – Page 47).

d.) At the rear back corner of the lid remove the 4 x 3mm x 30mm allen screws, nuts and washers.

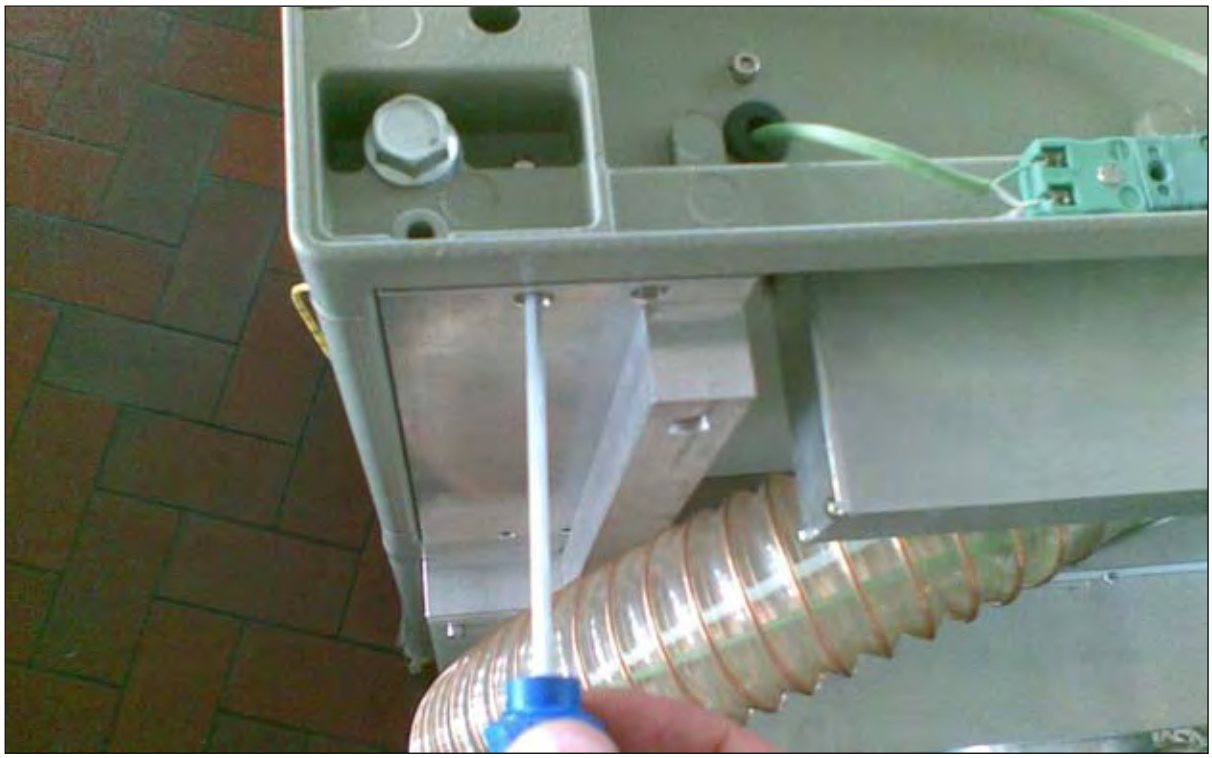


Fig. 3.16.1: BS – Removing of the 4 x 3mm x 30mm allen screws, nuts and washers

e.) Remove 4 x 2.5mm allen screw which attach the back cover to the lid.

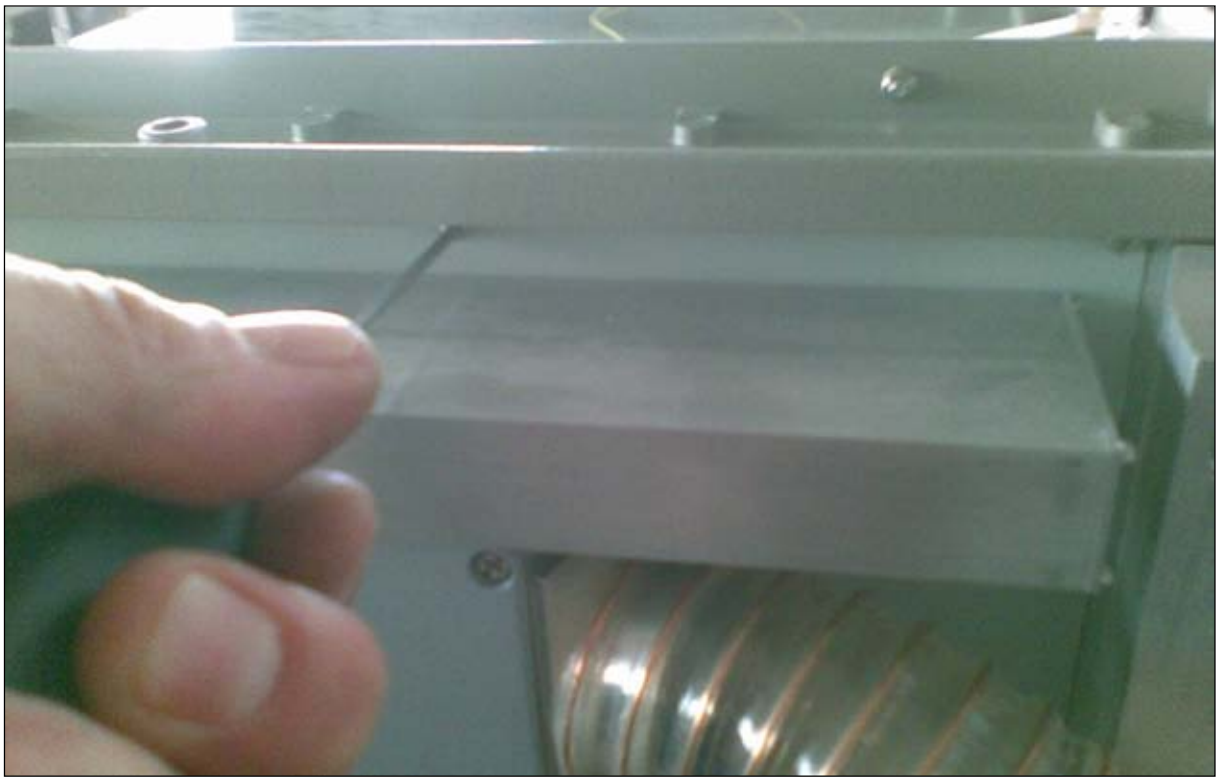


Fig. 3.16.2: BS - Removing back cover attaching screws

f.) On the RHS slide out the Thermocouple from the furnace (see Fig. 3.9.6 – Page 50).

g.) The thermocouple connects to the socket mounted at the rear inside the lid. Disconnect the two wires from the socket (green is +ve) and pull the wire through the rubber grommet in the lid (see Fig.3.28).

h.) Disconnect the purge tubes from the quick connect elbows where the enter the furnace, taking care not to apply force to the ceramic tube. The ceramic cement holding these tubes into the furnace is easily cracked.

i.) On the LHS inside the lid the three plastic purge gas tubes are connected to a quick fit tee connector. Take a note of the number on each tube (29, 30 & 31) and how the tubes are threaded and connected to the tee connector. Disconnect from the tee connector and pull the tubes clear from the lid.

j.) Remove the 4 x 13mm bolts from each corner of the top lid frame and carefully lift up from the front, slide forward and pivot backward to access the upper furnace. Hold the lid up in this position supported at the rear until the furnace wires are disconnected and clear of the lid.

Fig. 3.16.3: TS – Removing bolts attaching the cover frame

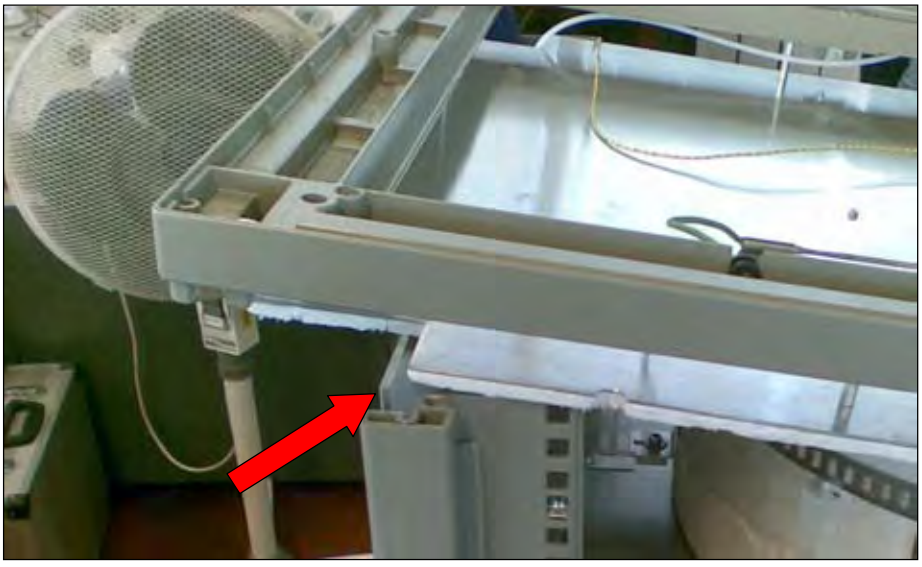


Fig. 3.16.4: TS - Lid lifted out of frame supported at the rear

k.) Disconnect the furnace wires and electrical supply wires from the terminals at the rear inside the lid. There is a blue wire on the LHS and black wire on the RHS. Pass these wires through the rubber grommets in the lid frame. The top lid frame can now be lifted clear of the lid.

Fig. 3.16.5: LHS/RHS – Disconnecting the furnace and electrical support wires

l.) Loosen the 5mm allen screw on the s/s strap around the furnace and carefully lift off, avoiding the electrical wires at the rear of the furnace and the gas purge connectors.

Fig. 3.16.6: Loosing the steel strap around upper heating element

m.) Loosen the 2 x 2.5mm allen screws securing each of the front three positioning supports and slide them forward to free the furnace.

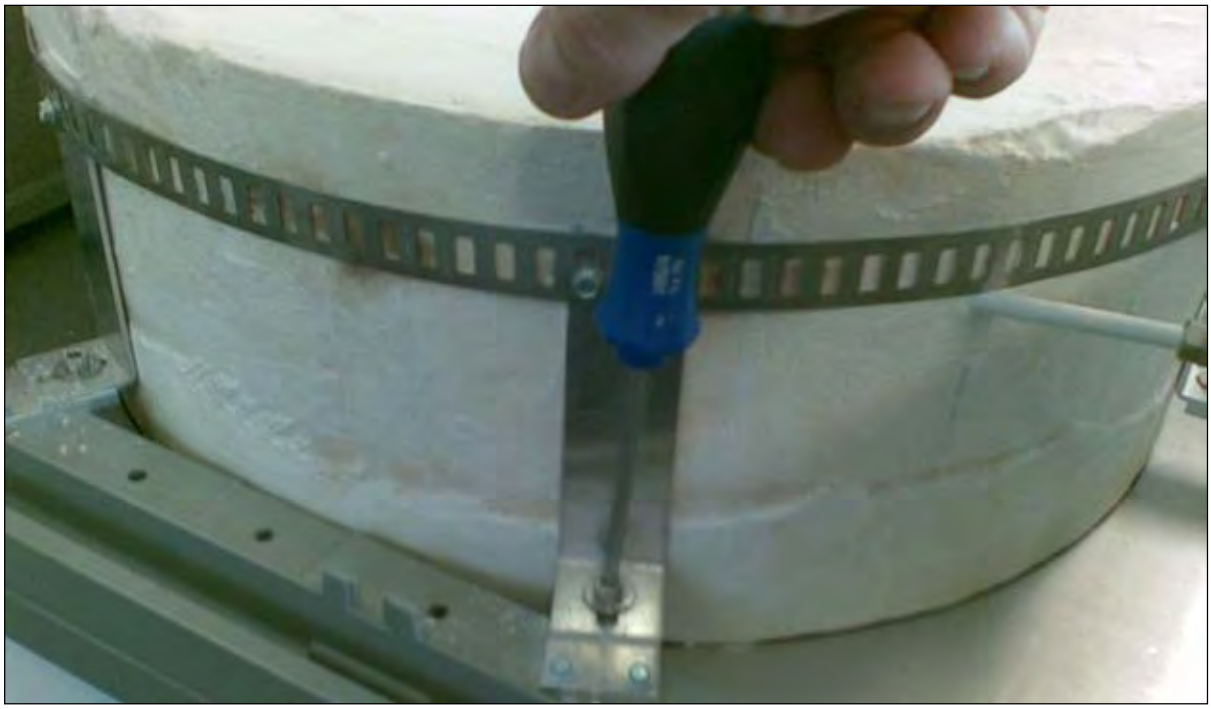


Fig. 3.16.7: Loosing the front positioning supports of upper heating element

n.) Unfasten s/s strap around the upper heating element.

Fig. 3.16.8: FS – Unfasten s/s strap

o.) Lift out upper furnace assembly.

When a new upper furnace is to be installed it must first have the ceramic purge gas tubes fitted and cemented in place. The ceramic tubes should not protrude more than 20mm inside the furnace wall. Once in position they should be fixed each side of the furnace with ceramic cement.

It is important that the lower furnace is correctly aligned before installing a new upper furnace. Check that the lower furnace is at the correct height and make adjustments as required – see lower furnace procedure.

3.17 Install of upper heating element

Unplug instrument from electrical supply and disconnect the compressed air supply.

a.) Place the upper furnace onto the rim of the lower furnace.
b.) Check that contact is made with the rear position supports and if necessary adjust so that the upright part of the rear supports touch the side of the furnace.
c.) Slide in the two front positioning supports and tighten the 2 x 2.5mm allen screws in each.
d.) Carefully place the s/s strap over the furnace so that the strap sits just under the ceramic tubes that carry the furnace wires. The strap should be positioned evenly around the furnace approximately 20mm down from the top edge with the clamp mechanism adjacent to the RHS front positioning support.
e.) Tighten the 5mm allen screw in the clamp until the furnace is held firmly. **Do not over tighten**.
f.) Check the alignment with the lower furnace by slowly raising and lowering the lid by hand. There should not be any interference.
g.) Reverse the above procedure from section 12 to complete the installation.

4. Miscellaneous

4.1 Diagram of Order-Numbers

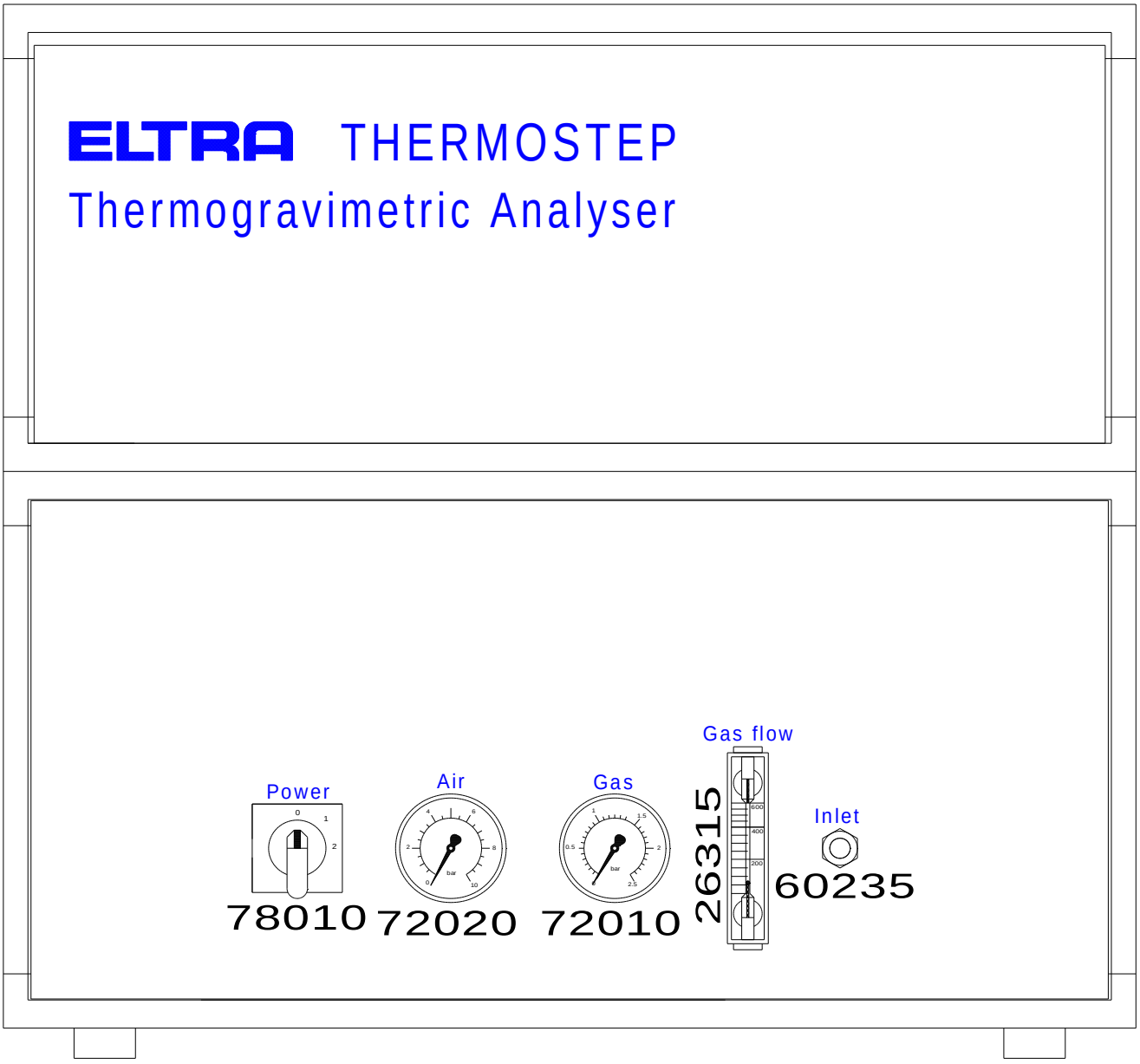


Fig. 4.1: View from the front

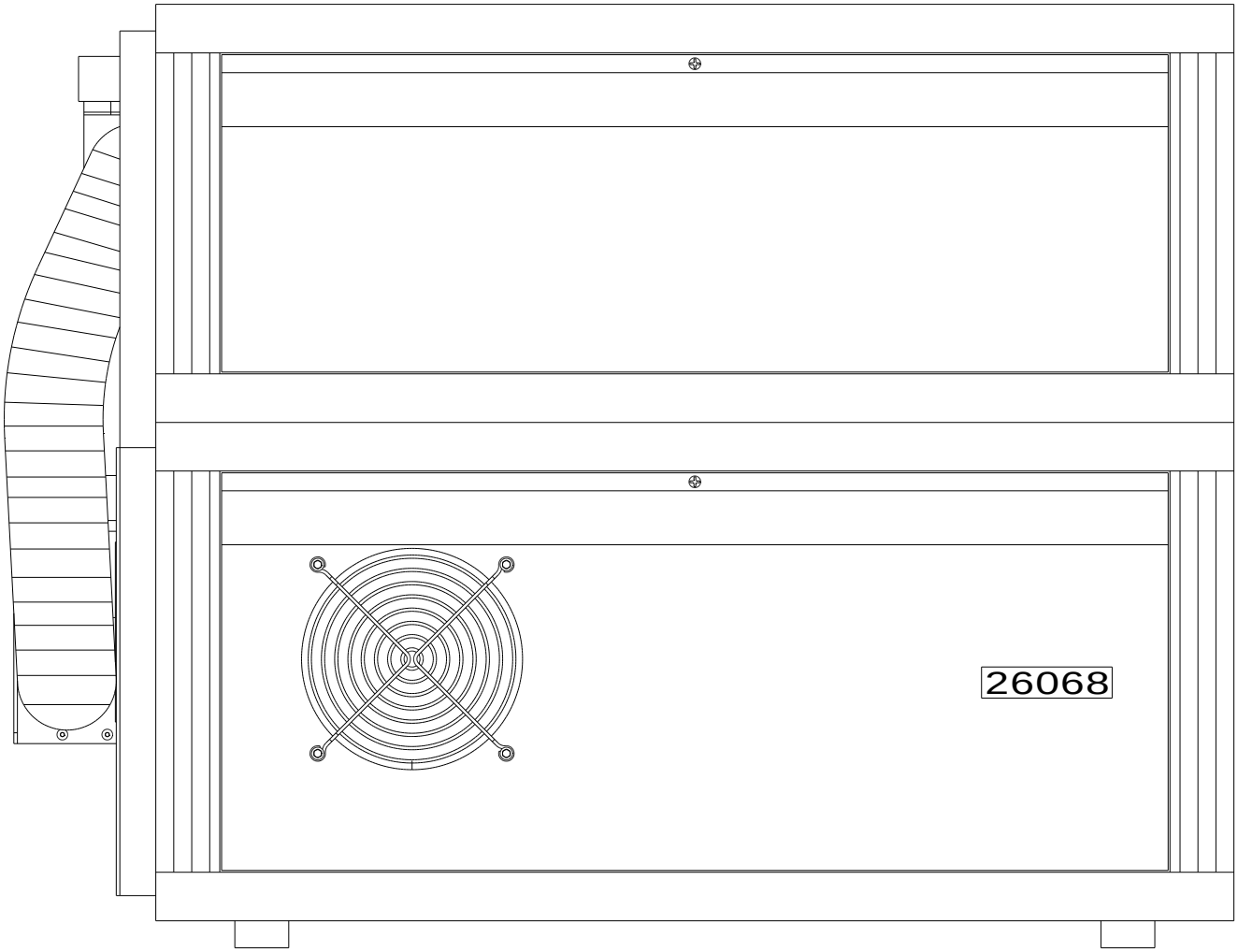


Fig. 4.2: LHS – lower side panel with notch for exhausting air tube

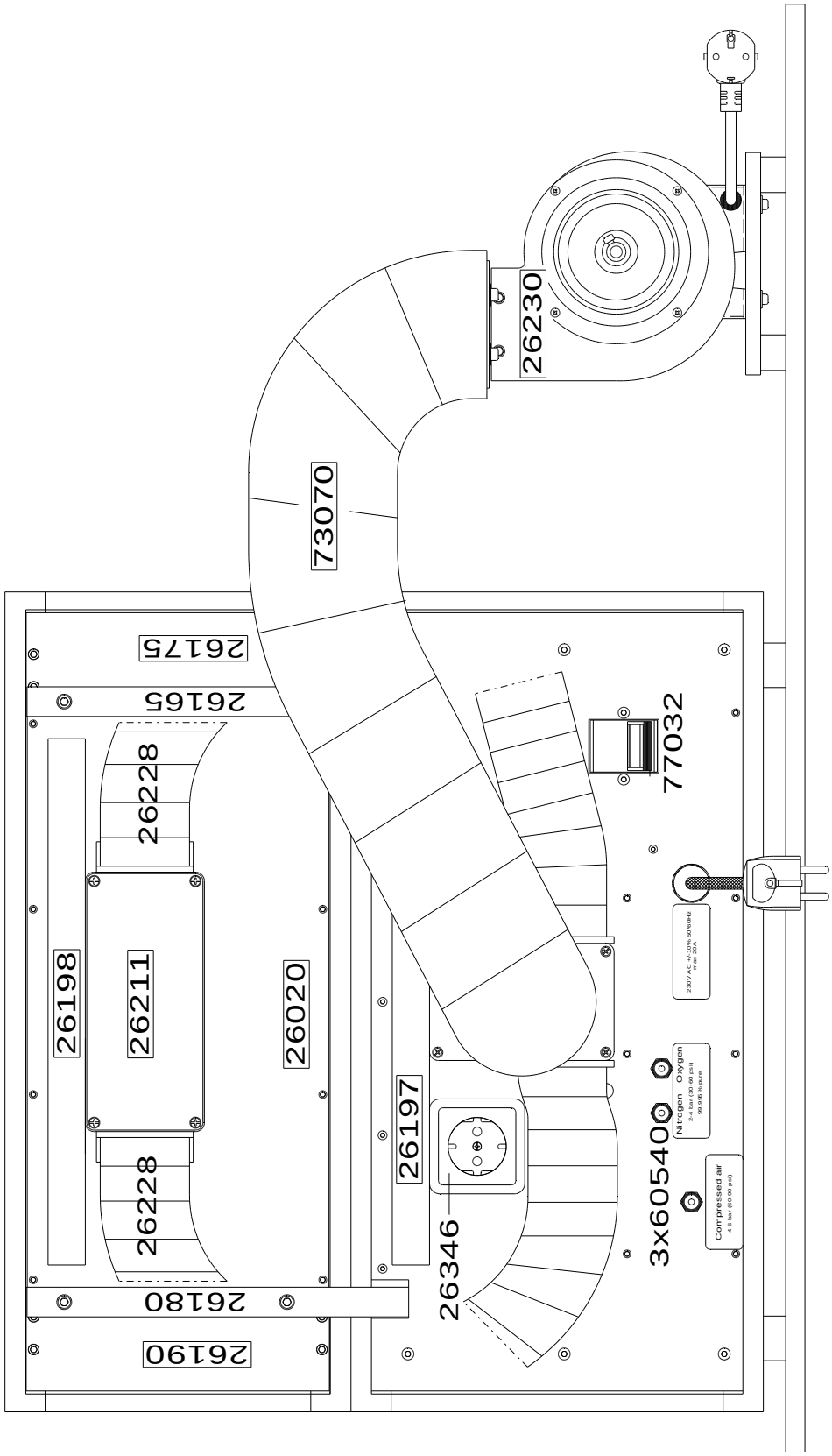


Fig. 4.3: Back side – with connected exhausting air tube and external blower

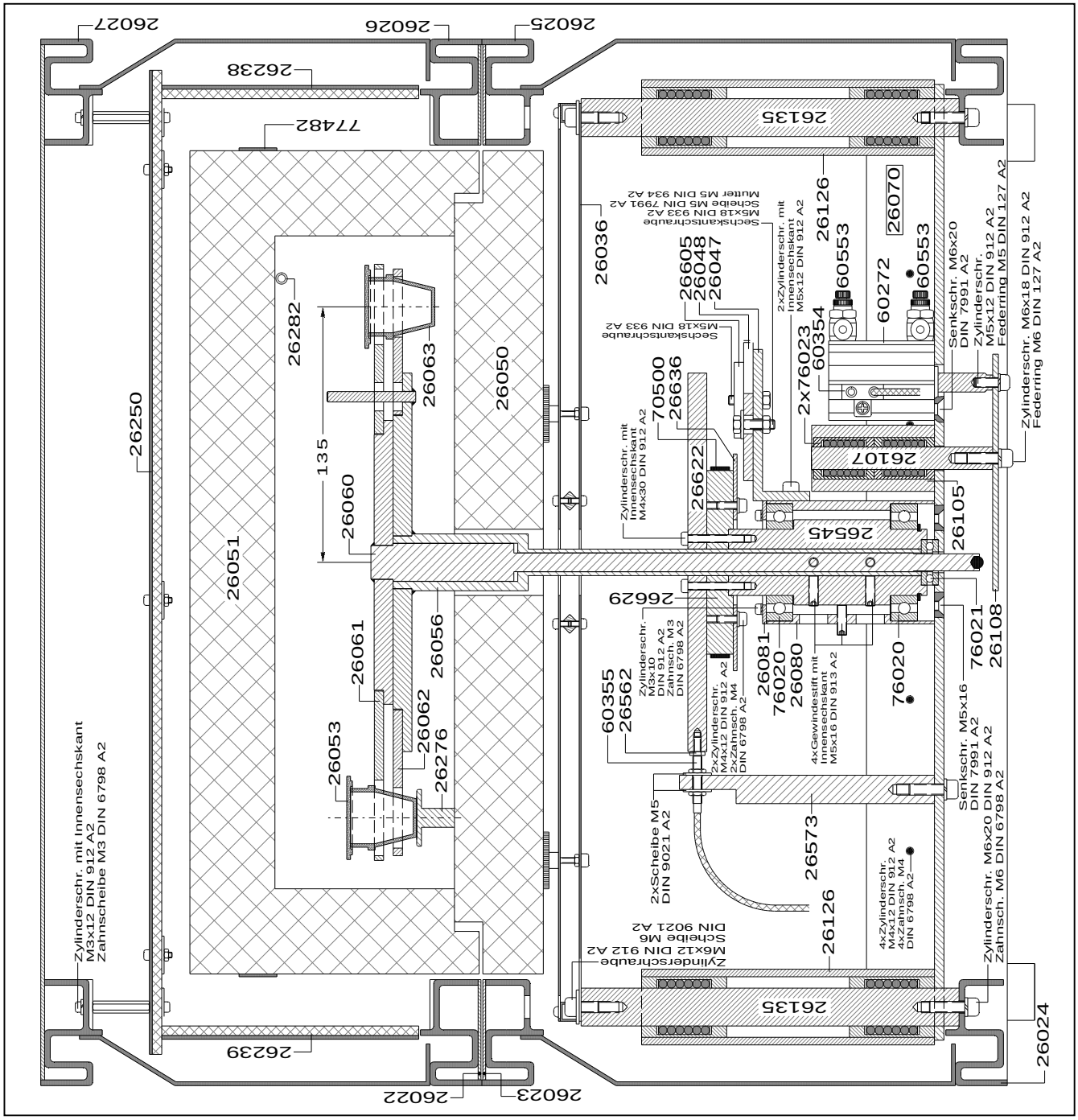


Fig. 4.4 : Cross-section – Side view

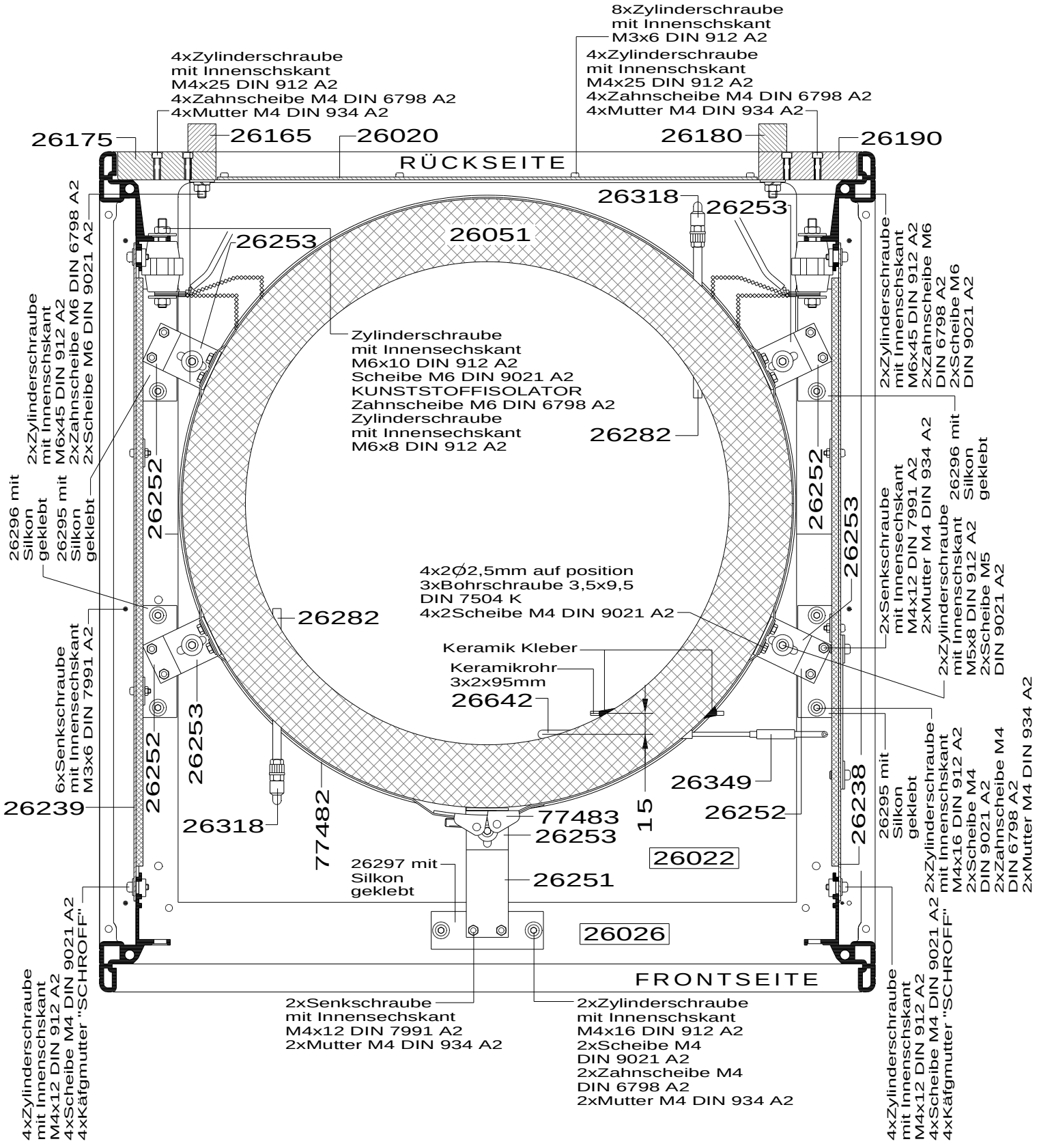


Fig. 4.5: Top view – upper heating element

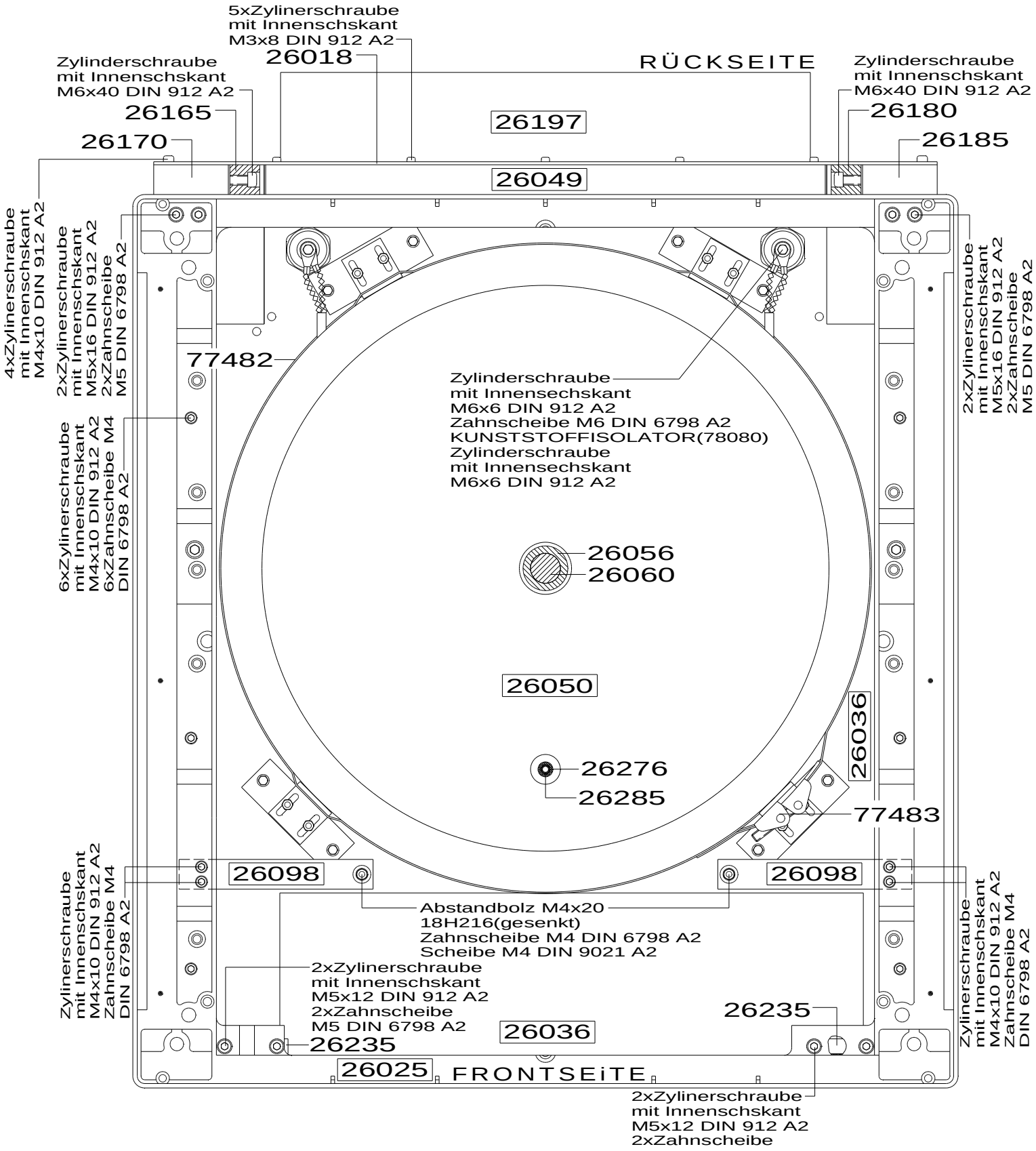


Fig. 4.6: Top view – lower heating element

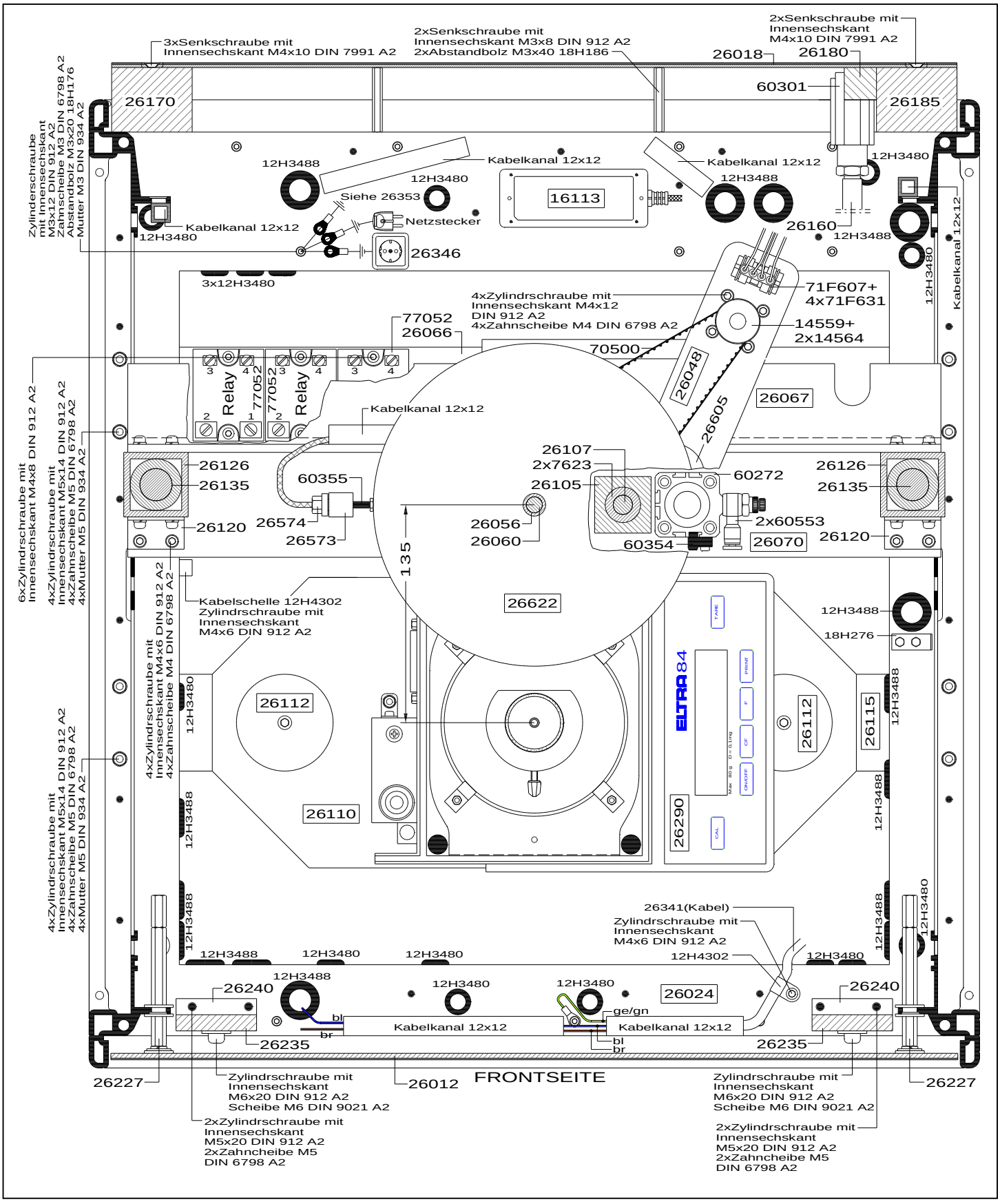


Fig. 4.7: Cross-section – Top view

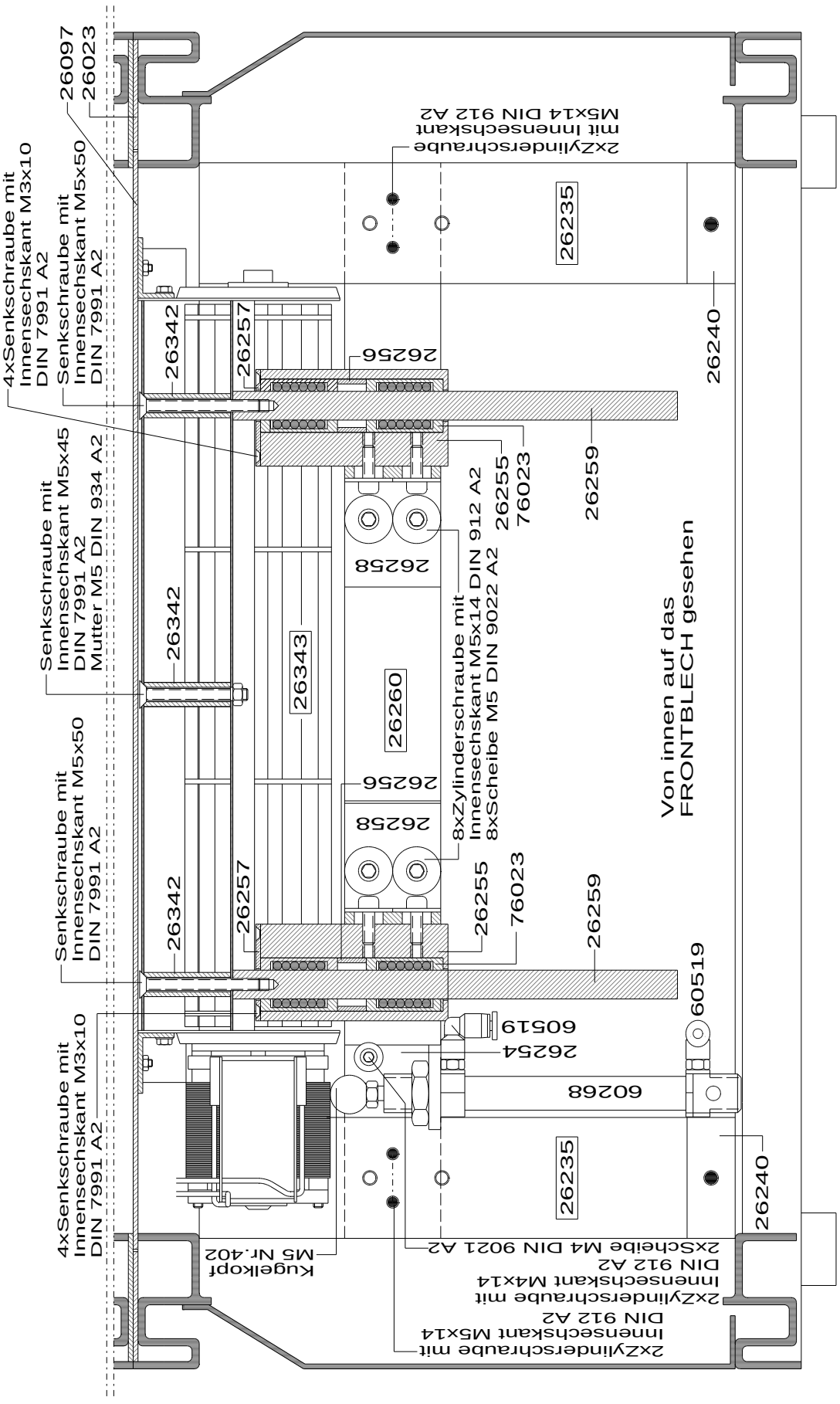


Fig. 4.8: Inside view to front metal plate

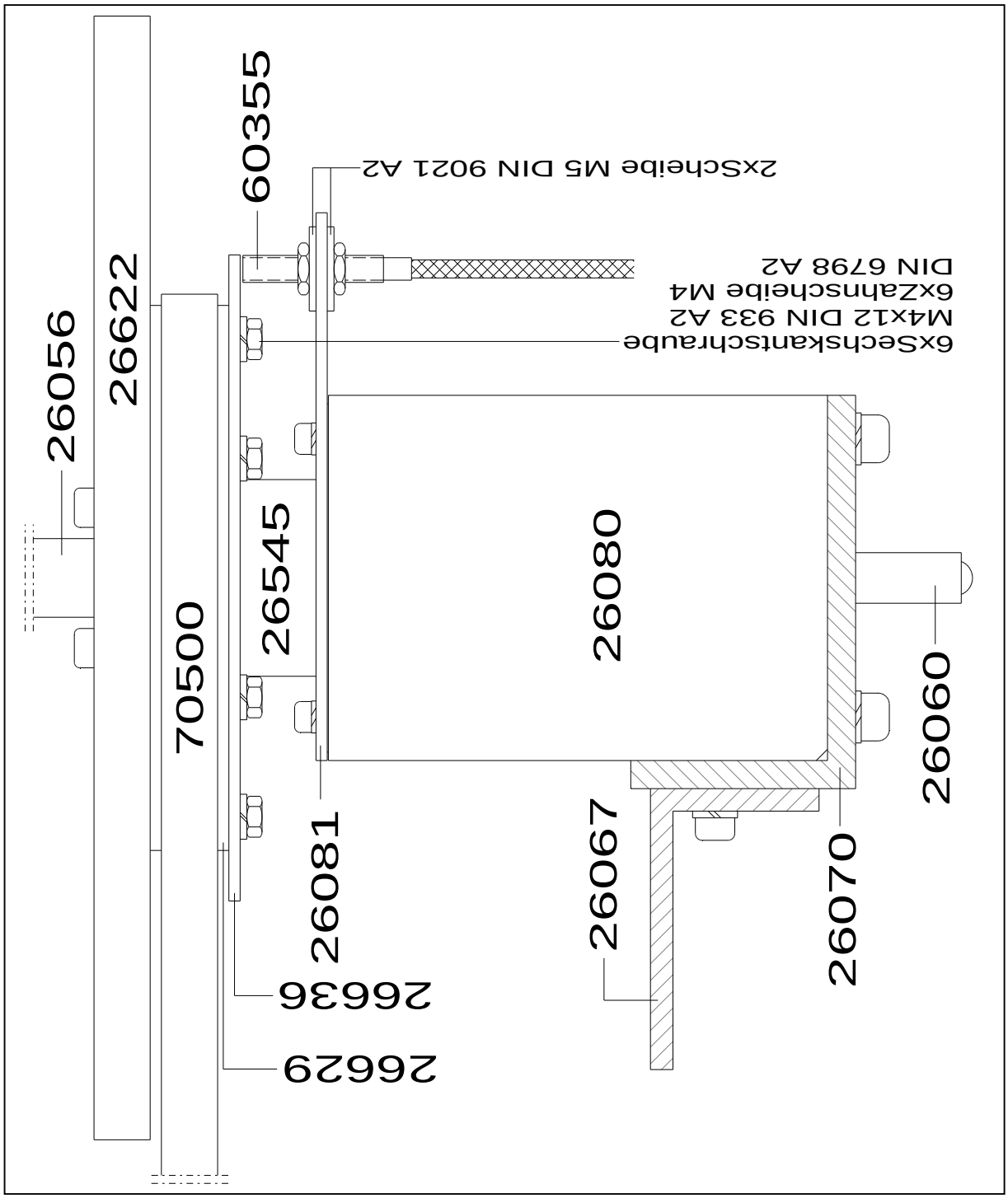


Fig. 4.9: Overview – Caroussel adaptor

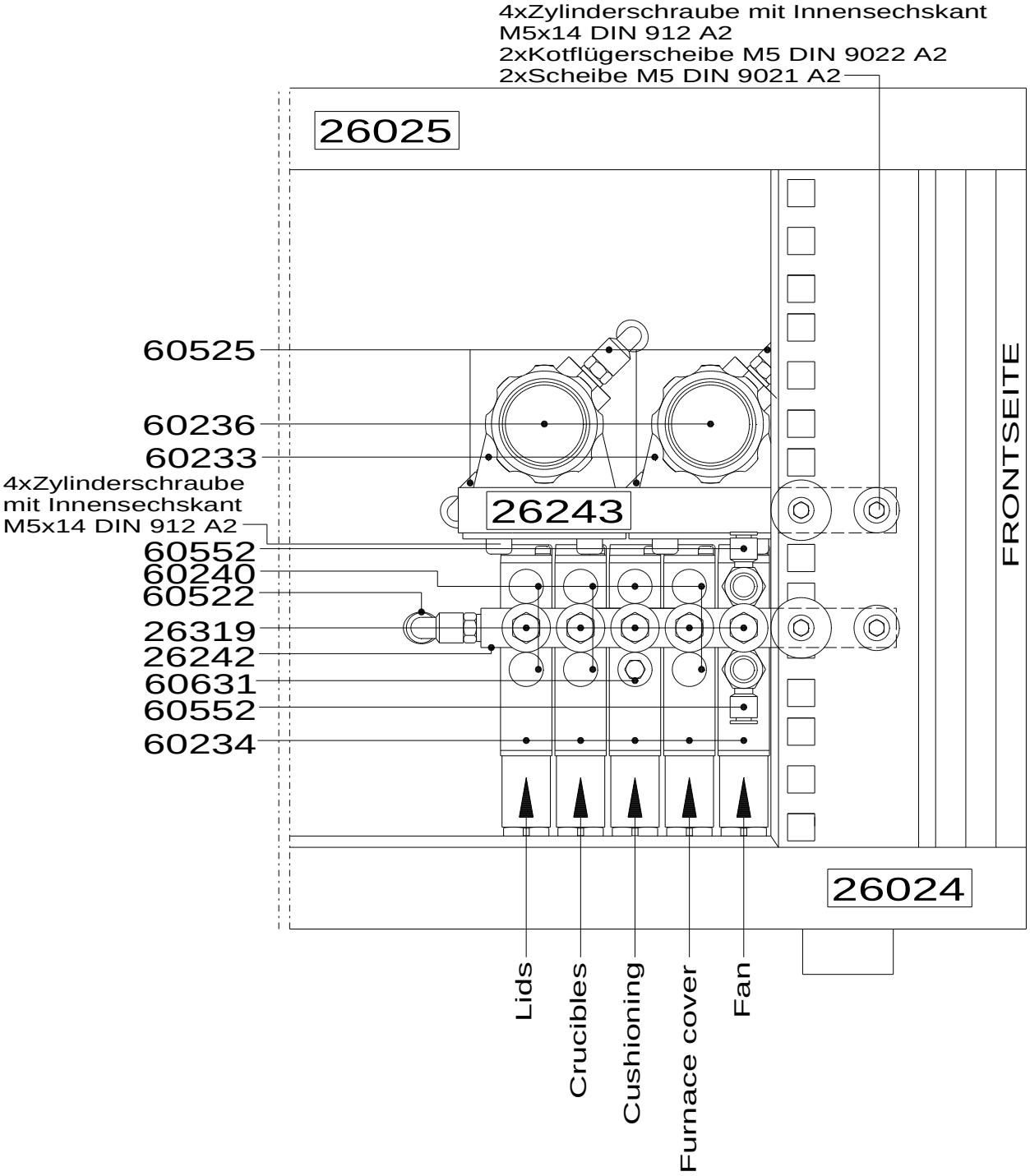


Fig. 4.10: LHS -Manifold

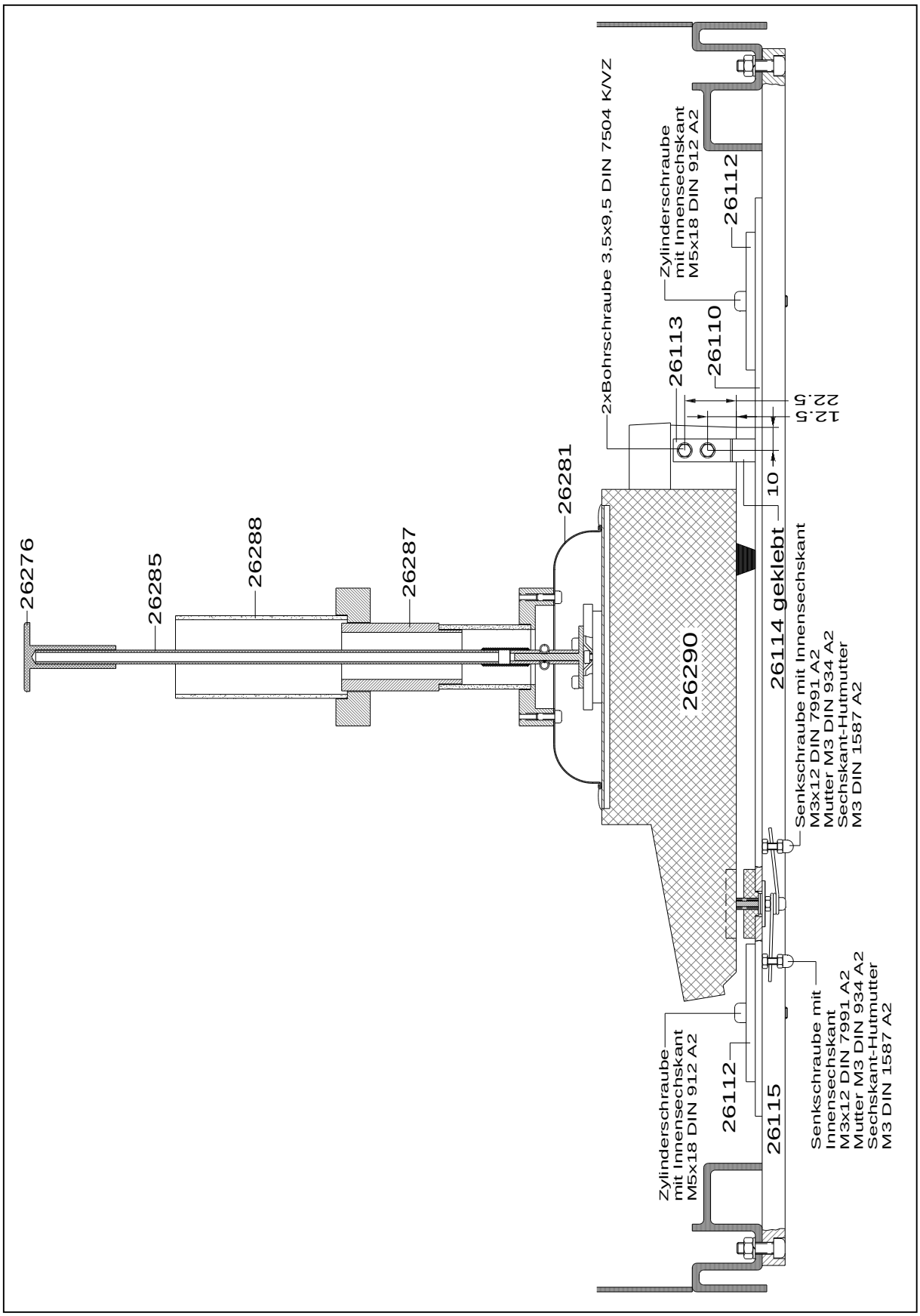


Fig. 4.11: Cross-section – Balance

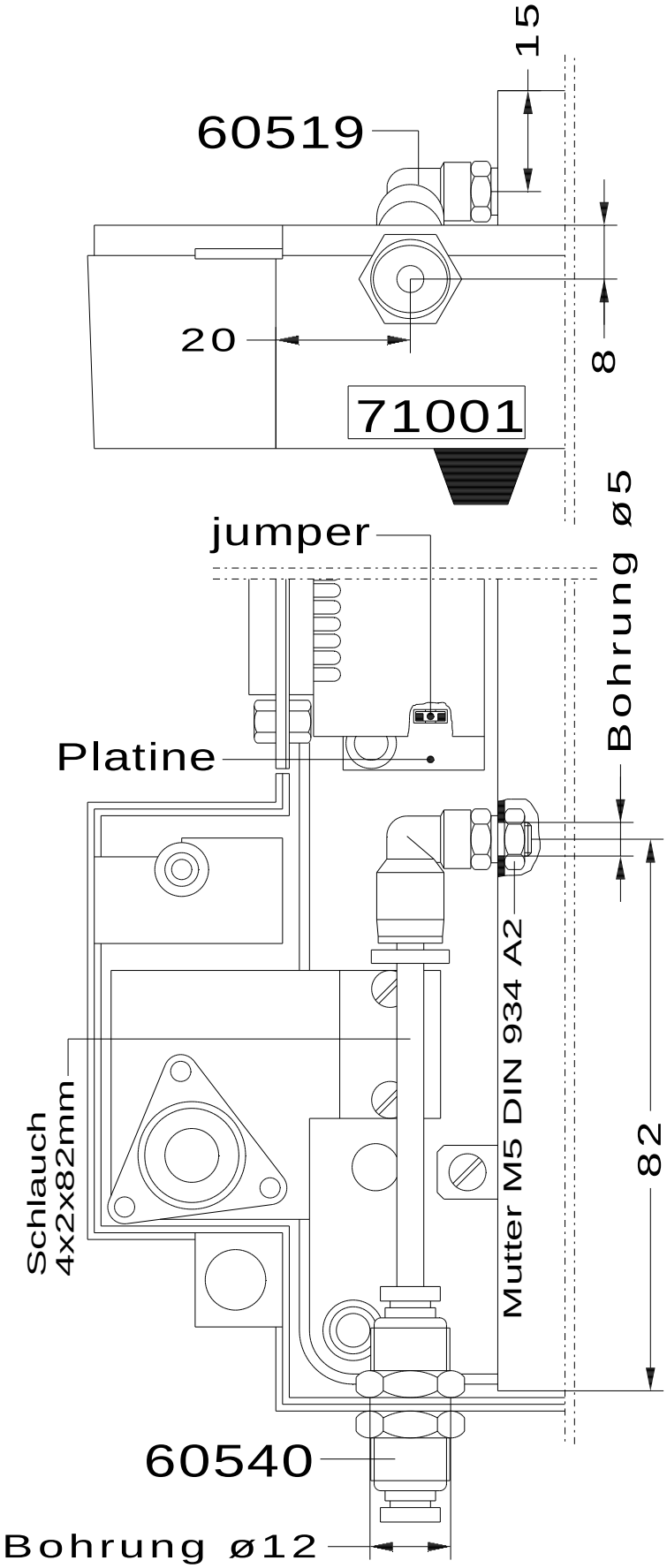


Fig. 4.12: Purging of balance

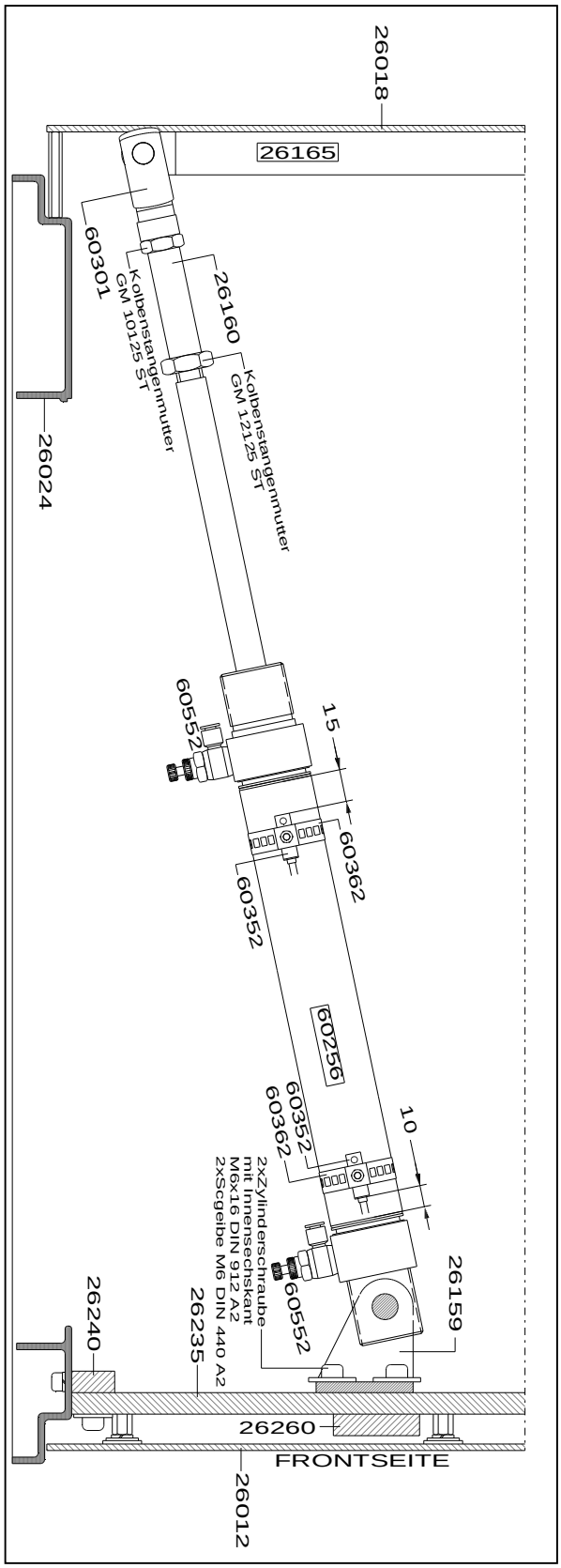


Fig. 4.13: Overview – Cover-Cylinder

4.2 Diagram of Wiring

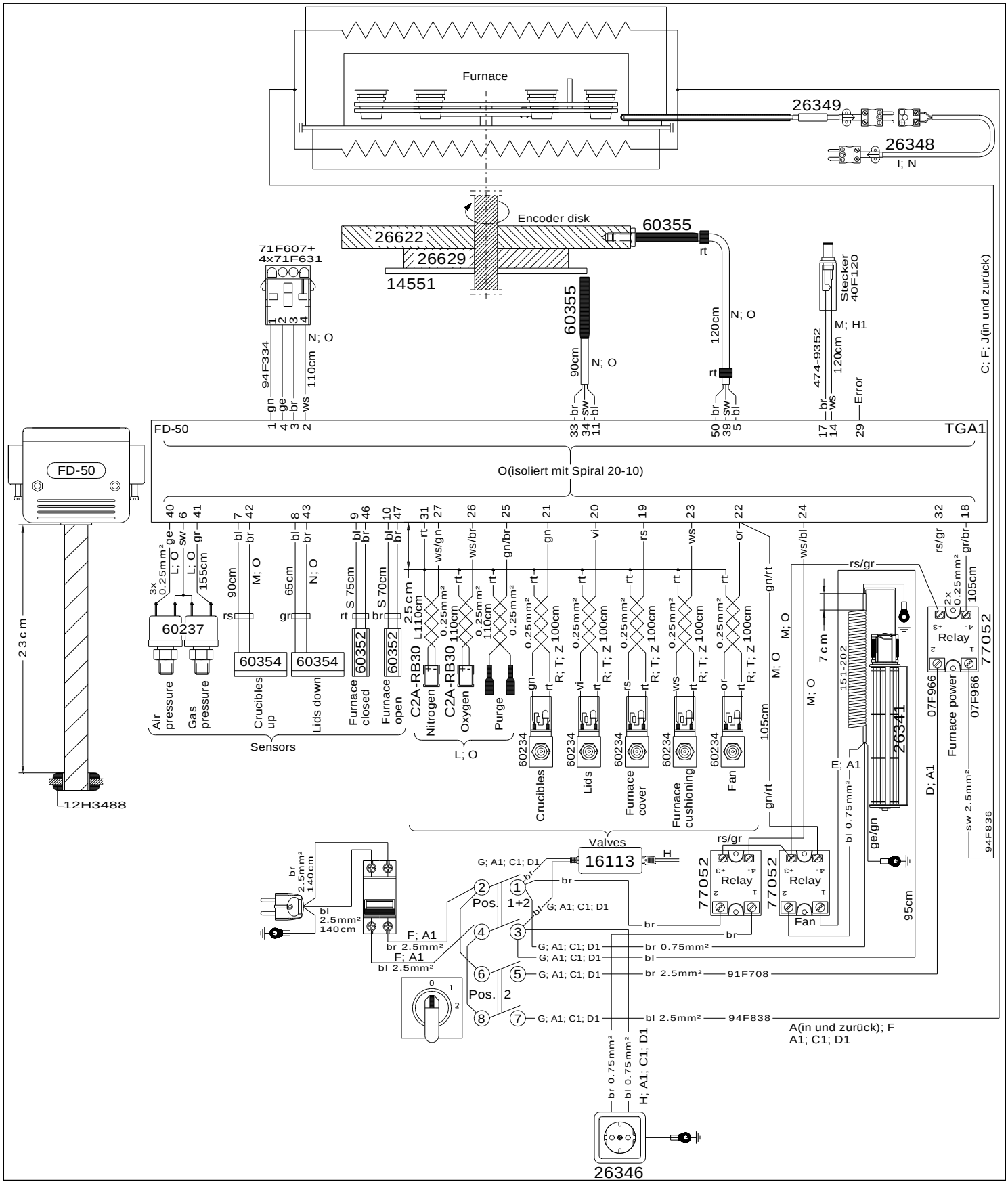


Abb. 4.14: Diagram of Wiring

4.3 Diagram of Gasflow

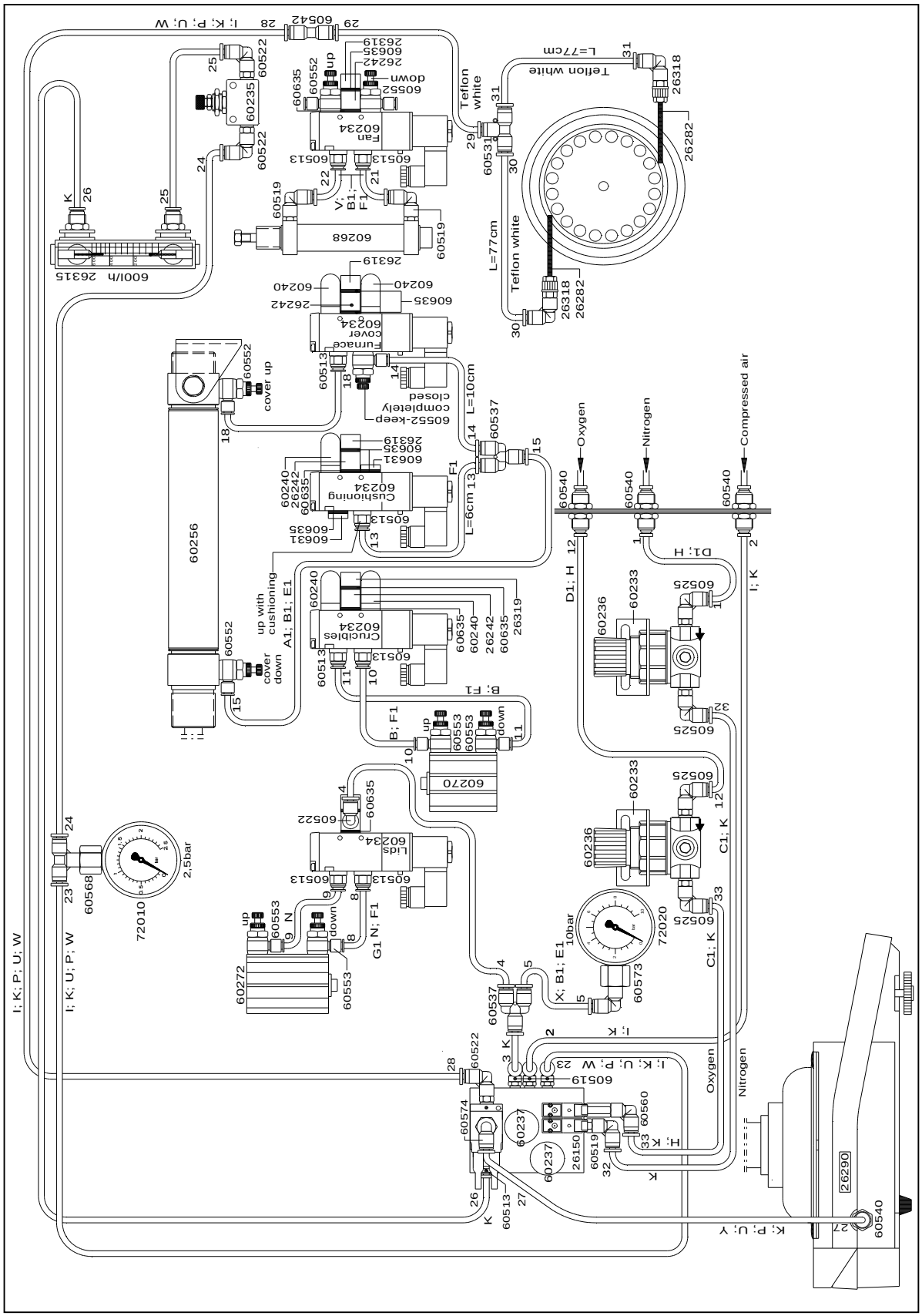


Fig. 4.15: Diagram of Gasflow

4.4 List of Abbreviations/Figures

BS – Backside
FI – Furnace inside
FS – Frontside
TS – Topside
LHS – Left Hand side
RHS – Right Hand side
TGA – Thermogravimetric Analyser

1. Starting up

2. Malfunctions

3. Service

4. Miscellaneous

Page 75: Fig. 4.15: Diagram of Gasflow