



## AVL 415S SMOKE METER GOO2 (FROM S/N 2500)



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# Warnings and Safety Instructions

This manual contains important **warnings and safety instructions** to be observed by the user.

The product described in this manual is intended for one specific area of application which is defined in the instructions. The manual also explains the essential requirements for the application and operation of the product as well as safety precautions to ensure smooth operation. AVL can provide no guarantee or accept any liability for applications other than those described in this manual or for applications where the essential requirements and safety precautions are not met.

The product may only be used and operated by qualified personnel capable of observing the necessary safety precautions. All accessories and equipment used with the product must be supplied or approved by AVL. The operating principle of this product is such that the accuracy of the measurement results depends not only on the correct operation and functioning of the product, but also on a variety of peripheral conditions beyond the control of the manufacturer. The results obtained from this product therefore must be examined by an expert (e.g. for plausibility) before any action is taken that is based on the results.

All adjustment and maintenance work necessary on instruments when open and under voltage must be carried out by a professional technician who is aware of the dangers.

All repairs to the product are to be carried out by the manufacturer or qualified service personnel only.

When the product is in use, an expert must ensure that neither the test object nor the testing equipment is operated under conditions that could lead to damage or injury.



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# 1 What You Should Know

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## 1.1 Safety Instructions

This documentation contains important **Warnings and Safety Precautions** which should be observed by the user. Only by careful observance of these requirements and safety precautions, a smooth operation can be guaranteed.

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## 1.2 About the AVL 415S Smoke Meter

Minimize your system downtimes by means of proactive measures. Our competent service engineers will carry out inspections and maintenance with technical professionalism and cost efficiency in mind. Using original spare parts guarantees high system reliability. AVL preventive maintenance assures the highest possible availability of the system and devices.

Your benefits at a glance:

- Best availability of equipment due to minimized down times
- Guaranteed service quality through certified engineers
- Easy budgeting due to transparent maintenance costs
- Maintenance plans optimized for the used equipment and its applications

A typical preventive maintenance procedure comprises the following steps:

- Visual check
- Performance checks
- Cleaning
- Replacing wear parts
- Calibration and re-adjustment
- Calibration protocols
- Failure diagnostics
- Recommendation for repair

Required manpower:

The required time for an annual maintenance by an AVL Service Engineer is 6 hours.

Obviously, this time might depend of the usage and the environment conditions of the device.

The frequency we recommend in this document is based on normal operating hours (8 hours/working day).

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### Information

This manual refers to the maintenance of a Smoke Meter 415S.

Handling and actions are mainly the same as for the Generation 1 Smoke Meters, but the spare parts can be different.

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## 1.3 About this Documentation

The documentation addresses service engineers who perform maintenance tasks of the AVL 415S Smoke Meter. All relevant tasks are described, all necessary wear and spare parts are listed.

Detailed knowledge about the device and the relevant safety regulations is essential.

For detailed information on the AVL 415S Smoke Meter see the corresponding manuals:

- *AT1240E 415S Smoke Meter, Operating Manual*
- *AT3648E 415SE Smoke Meter, Product Guide*
- *AT3803E 415SE Smoke Meter, Calibration Manual*

The descriptions in this manual are based on the AVL Instrument Controller IC 4210.

If the DUI (Device User Interface) is used for the maintenance work, see also:

- *AT3569E 415S Smoke Meter, Device User Interface, User's Guide*

### 1.3.1 Typographic Conventions

**Safety messages:**



**WARNING**

WARNING indicates a hazardous situation which – if not avoided – could result in death or serious injury.

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**CAUTION**

CAUTION indicates a hazardous situation which – if not avoided – could result in minor or moderate injury.

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**Additional messages:**

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**NOTICE**

This text indicates situations or operation errors which could result in property damage or data loss.

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**Information**

This text indicates important information or operating instructions. Not observing these instructions could inhibit or impede you from successfully completing the tasks described in this documentation.

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**Standard text styles:**

<b>Bold</b>	Parameters; control elements in windows and dialog boxes; important text
<i>Italics</i>	Cross-references; foreign-language or new terms; wild-card for elements that need to be entered by the user, i.e. characters or text. If you read, for example, <i>macro name</i> , you are required to type the name of a macro.
UPPERCASE LETTERS	Operating modes
Courier	Programming examples; source code
Times New Roman	Formulas
<b>Menu   Option</b>	Description of how to select a menu item from a given menu

**Lists:**

1.	Step-by-step procedures with a given sequence
2.	
•	One-step instructions
▪	Unordered series of concepts, items or options
▪	
–	

**1.3.2 We Want to Hear from You**

Your comments and suggestions help us to improve the quality and practical relevance of our manuals.

If you have any suggestions for improvement, please send them to:

docu@avl.com

We look forward to hearing from you!



## 2 Maintenance

### 2.1 Procedure

#### NOTICE

For **permanent operation** of the measuring device (fully automated endurance runs, 24 h/day, 6 ... 7 days/week), a service is recommended every 3 weeks. A full service or replacing the pump is recommended every 3 months.

When the device is put to **average use**, we recommend:

1. Each time the paper is changed, perform the following steps:
  - Inspect the reflectometer head - clean if necessary (do not forget to clean also the light gate 1).
  - Inspect the two fine filters and replace if there are any signs of soiling.
  - Inspect the blackened filter area.
  - Perform a leak check.
  - Check white value disk for soiling and clean if necessary.
  - Lubricate moving parts of the camshaft and the ratchet clip by using Teflon lubricant oil (material number: HS0064) or Teflon lubricant spray (material number: HS0058).
2. After 300 operating hours or 10 000 measurements (corresponds to 5 ... 10 paper rolls - material number HP0153SP) do the following:
  - Check the reflectometer head.
  - Check the sampled volume.
  - Clean sampling line tube with ultra-clean, oil-free and water-free compressed air.
  - Clean the light gate 1 with ultra-clean, oil-free and water free compressed air.
  - Check filter mat for cooling air.
  - Check the ratchet clip and the clamping lever.
  - Carry out all the activities described in the following sections.
  - Replace all fine filters.
  - Clean and lubricate moving parts of camshaft and ratched clip using Teflon lubricant spray (material number HS0058) or Teflon lubricant oil (material number HS0064).
  - Check pump noise and check nominal pump flow.

## 2.2 Service Intervals

### 2.2.1 AVL Service Engineer - Annual Maintenance Activities

Component / Test	Lifetime / Service interval	Maintenance	Replacement
<b>Leak check</b>	Annually	For checks of sample lines and probes: supported on SERVICE MODE only perform with sampling probe & line Special sampling	–
<b>Reflectometer head</b>	Annually	Check and clean or replace if necessary. Adjustment if necessary and calibration.	Every 2 years
<b>Light gate 1</b>	Annually	Check and clean if necessary.	If damaged, replacement is done by an AVL Service Engineer.
<b>Camshaft</b>	Annually	Check and clean or replace if necessary.	Every 2 ... 3 years or after 3 000 operating hours.
<b>Fine filters</b>	Annually	Replace.	Annually
<b>White value plate</b>	Annually	Clean the deposit on the standard.	If necessary.
<b>Filter paper</b>	Annually	Check the homogeneous blackening with exactly delineated round contour.	–
<b>Sealing ring of the suction unit</b>	Annually	Check there is no deposit, clean if needed. Glue the sealing rings into the clamping device (suction unit). Check the sealing ring for defects and correct sealing ring position.	Replacement of the sealing rings if damaged.
<b>Clamping piece rolls, axles press fit bush bearing</b>	Annually	Clean and lubricate all points.	If necessary.
<b>Sampling probe, sampling line</b>	Annually	Check and clean.	1 000 – 2 000 operating hours.
<b>Filter mat</b>	Annually	Replace.	Annually
<b>Check sampled volume</b>	Annually	Check.	Replacement of the glass caliber of the volume tester is necessary when it is scratched, or contaminated with dirt.
<b>Adjustment of the transport paper mechanism</b>	Annually	Function check and adjustment necessary every time spare parts are exchanged.	–
<b>Adjustment of the slip clutch</b>	Annually	Check the tension and adjustment if necessary.	–
<b>Ratchet clip</b>	Annually	Replace.	Annually

Tab. 1

Component / Test	Lifetime / Service interval	Maintenance	Replacement
Clamping lever	Annually	Visual check.	If damaged or if any part is bent off.
Pump	Annually	Check and replace if necessary.	Every 2 000 - 3 000 operating hours.
Nipple & hose connections	Annually	Replace.	Annually
Cleaning of electronical boards	Annually	Clean with high purity compressed air.	If necessary or defective.
Check valve	Annually	Check and replace if necessary.	Annually
Pressure reduction assembly	Annually	Check.	After assembly.
Pressure switch of shop air option	Annually	Check and adjust if necessary.	Annually

Tab. 1

## 2.2.2 Service Engineer - Maintenance Schedule



### WARNING

#### Fire hazard

When using the required appliances like sprays, mounting pastes, lubricants, always observe the relevant handling instructions and safety measures of the various products.

All sprays used are a fire hazard and highly inflammable. Installation work using the appliances on and inside measurement devices and on test beds must only be carried out on cooled-down parts and in well ventilated areas.

### NOTICE

The compressed air used to clean, has to be **absolutely** free from oil, water, and particles.

For the disposal of environmentally sensitive substances, see the *AVL 415S Smoke Meter Operating Manual*, chapter *Disposal of Environmentally Sensitive Substances*.

Component / Test	Lifetime / Service interval	Maintenance	Replacement	Procedure
<b>Leak check</b>	Minimum every day. After every filter paper change. After every manipulation of the paper transport. Before & after every volume tester calibration.	For checks of sample lines and probes:  supported on SERVICE MODE only perform with sampling probe & line and special sampling	–	Section <i>Leak Check</i> on page 41
<b>Reflectometer head</b>	Every time the filter paper is exchanged.	Check and clean if necessary with a puffer or a soft brush or with compressed air.	Every 2 years	Section <i>Reflectometer Head</i> on page 27
<b>Light gate 1</b>	Every time the filter paper is exchanged.	Check and clean if necessary with compressed air.	If damaged – <b>Replacement is done by an AVL Service Engineer.</b>	
<b>Camshaft</b>	Every time the filter paper is exchanged.	Check and clean if necessary with compressed air.	Every 2-3 years or after 3 000 operating hours.	Section <i>Camshaft</i> on page 30
<b>Fine filters</b>	Every time the filter paper is exchanged.	Check.	Following the usage conditions.	Section <i>Fine Filters</i> on page 31
<b>White value plate</b>	Every time the filter paper is exchanged.	Clean the deposit on the standard with a soft, wet cloth.	–	Section <i>Clamping Lever and Ratchet Clip</i> on page 28
<b>Filter paper</b>	Every time the filter paper is exchanged.	Check the homogeneous blackening with exactly delineated round contour.  Check the backside of the filter paper for back flushed particles.	–	Section <i>Blackened Filter Area</i> on page 22
<b>Sealing ring of the suction unit</b>	Minimum every 5 times of filter paper exchanged.	Check if there is no deposit, clean if necessary with a soft or a damp cloth.  Glue the sealing rings into the clamping device (suction unit) with Adhesive 3M-B20.  Check the sealing ring for defects and correct sealing ring position.	Replacement of the sealing rings if damaged; in this case also order mounting ring 30 mm.	Section <i>Suction Unit</i> on page 24

Tab. 2

Component / Test	Lifetime / Service interval	Maintenance	Replacement	Procedure
<b>Clamping piece rolls, axles press fit bush bearing</b>	Required after 4-5 exchanges of the filter paper roll, or after 10 000 measurements, or after 300 operating hours of the pump.	Clean and lubricate all points with Teflon lubricant spray or Teflon lubricant oil.	If necessary.	Section <i>Lubricating and Cleaning Intervals</i> on page 18, section <i>Lubrication Points</i> on page 19
<b>Sampling probe, sampling line</b>	For Diesel engine: minimum once a week, or after 300 operating hours of the pump.  For low meas. emission: once a week  For high HC concentration: everyday	Check and clean with compressed air.	1 000 – 2 000 operating hours.	Section <i>Sampling Probe and Sampling Line</i> on page 23
<b>Filter mat</b>	Every 300 operating hours of the pump, or after 10 000 measurements	Visual check and clean if necessary with compressed air.	-	Section <i>Cooling</i> on page 33
<b>Check sampled volume</b>	Recommended: every 300 operating hours of the pump, or after 10 000 measurements.  Necessary: after 1 000 operating hours.	Check recommended after: Installing/reinstalling the device on the test bed. When changing the dead volume. After cleaning the device from the soot contamination. After repairing the device. Re-adjustment.	Replacement of the glass caliber of the volume tester is necessary if it is scratched or contaminated with dirt.	Section <i>Sampling Volume Check</i> on page 37
<b>Adjustment of the transport paper mechanism</b>	Every 1 000 operating hours.	Function check and adjustment is necessary every time spare parts are exchanged. Clean disassembled parts in ultrasonic bath or replace them.	-	Section <i>Suction Unit</i> on page 24
<b>Adjustment of the slip clutch</b>	Every 1 000 operating hours or once a year.	Check the tension and adjust if necessary.	-	Section <i>Filter Paper Transport and Spool Device</i> on page 32

Tab. 2

Component / Test	Lifetime / Service interval	Maintenance	Replacement	Procedure
<b>Ratchet clip</b>	Every 300 operating hours. Every 6 months .	Visual check and clean if necessary.	When ratchet clip rolls damaged or deformed.	Section <i>Clamping Lever and Ratchet Clip</i> on page 28
<b>Pump</b>	Every 1 000 operating hours. Every 2 000 - 3 000 operating hours.	Flow check. Check and replace if necessary.	Every 2 000 - 3 000 operating hours.	Section <i>Pump</i> on page 34
<b>Electrical boards</b>	Once a year or if contaminated.	Visual check. Clean with compressed air.	–	–
<b>Pressure reduction assembly</b>	Once per week or after assembly.	Check and adjust if necessary.	–	

Tab. 2

## 2.3 Components

### 2.3.1 Disposal Instructions

#### NOTICE

Dispose of used filter paper rolls, fine filters, hose connectors and chemical agents (e.g. bonding agents or sprays) in accordance with the statutory requirements applicable in your country.

Remember that hoses and hose connectors contain fluorine. Observe the statutory requirements in your country when you wish to dispose of this product or components thereof (e.g. directives on the disposal of electronic waste).

Observe the handling instructions, application notes, storage and transport instructions, instructions for disposal, and safety instructions of the products as well as the country-specific regulations.

All appliances have to be treated as hazardous waste.

For detailed information on disposal instructions see the AVL 415S Product Guide.



## 2.3.2 Paper Feed Mechanism

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### NOTICE

The lifetime of the paper feed mechanism components depends heavily on correct on-site maintenance. If the following activities are not done in time, the lifetime of the paper feed mechanism will be considerably reduced. The mentioned intervals are typical, recommended values that might even be shorter if the system is exposed to additional stress caused by heavy contamination with particulate matter or by contamination present in the ambient air.

Basically, the following applies: If you notice that "lubricant oil or lubricant grease" is no longer "liquid" at the lube points, or if the deposits have already turned black or exhibit an "almost solid or stiff consistency", all moving parts have to be completely cleaned to remove any abrasion, deposits, residues of lubrication agents etc. Furthermore, a subsequent re-lubrication of the system is necessary.

A complete cleaning and re-lubrication of all moving parts is also required (imminent danger) if you can hear "squeaky", "rubbing", "grating", "crunching" or "grinding" noises during paper feed.

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### Information

In general, the currently defined Teflon lubricant oil can be used in the same way as it has been used in the past. However, it is absolutely necessary to adhere to the defined lubricating and cleaning intervals.

Points or system parts for which lubricant grease should preferably be used or which only require the use of lubricant oil (or lubricant spray) are marked separately in the following illustrations.

If the measuring system is not used continuously (means approx. 5 days a week; approx. 50 weeks a year) the general use of HS0064 as lubricant agent is recommended.

#### Lubricating agents:

- Teflon Lubricant Oil (material number HS0064)
  - Teflon Lubricant Spray (material number HS0058)
  - Lubricant Grease OKS 260 (material number HS0071); only for systems which are in permanent use (7 days a week, > 300 days a year).
-

### 2.3.2.1 Lubricating and Cleaning Intervals

1. After 3 to 4 paper rolls (material number HP0153):
  - Lubricate the moving parts of the paper feed mechanism with Teflon lubricant oil or Teflon lubricant spray, as currently given in the manual.
2. After approx. 5 to 10 paper rolls or after 300 operating hours or every **10,000** measurements (whatever occurs sooner):
  - Perform a simple cleaning of the parts of the paper feed mechanism to remove the coarsest soiling.
  - Then lubricate all moving parts (with lubricant grease and/or with lubricant oil or lubricant spray).
3. After (every) approx. **50** paper rolls:
  - Complete cleaning of all parts of the paper feed mechanism to remove all deposits and re-lubrication of all parts (all rotating and sliding parts; this also concerns the inside parts of the shafts and rollers that can be taken apart).
  - Check the parts for wear and replace any affected components.
  - Perform a complete cleaning of the device to clear any kind of contamination present such as paper fibers, particulate matter or any other system contamination.
4. After (every) approx. 100 / 300 (**200**) paper rolls:
  - Check and, if required, replace the PU roller and the ratchet clip rollers (if required, also the entire assembly including axles and rollers - see *Fig. 4* on page 22 - Pos. 110 to 150, or alternatively, replace the entire ratchet clip).
  - Perform all activities of step 3.

---

#### NOTICE

The elastomer roller (*Fig. 4* on page 22) on the ratchet clip cannot be cleaned. This part has to be disassembled before cleaning the other mechanical parts or it has to be replaced.

After cleaning of all parts they must be lubricated as shown in *Fig. 1* to *Fig. 4*.

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5. After approx. 1 000 paper rolls:
  - Order an AVL service engineer: parts, such as the motor, camshaft bearings, ratchet clip, clamping lever, suction unit or other worn-out component parts, have to be checked by an AVL service engineer, who will then decide if replacement is necessary.

### 2.3.2.2 Lubrication Points

#### Information

#### Lubrication and cleaning points (Fig. 1-Fig. 4)

- **Blue frame:**  
Lubrication only with Teflon lubricant oil (material number HS0064) or Teflon lubricant spray (material number HS0058).
- **Red frame:**  
Lubrication (preferably) with lubricant grease (material number HS0071) or also with lubricant oil or lubricant spray.

The marking applies for all lube points.

All marked lube points need to be cleaned on a regular basis too.

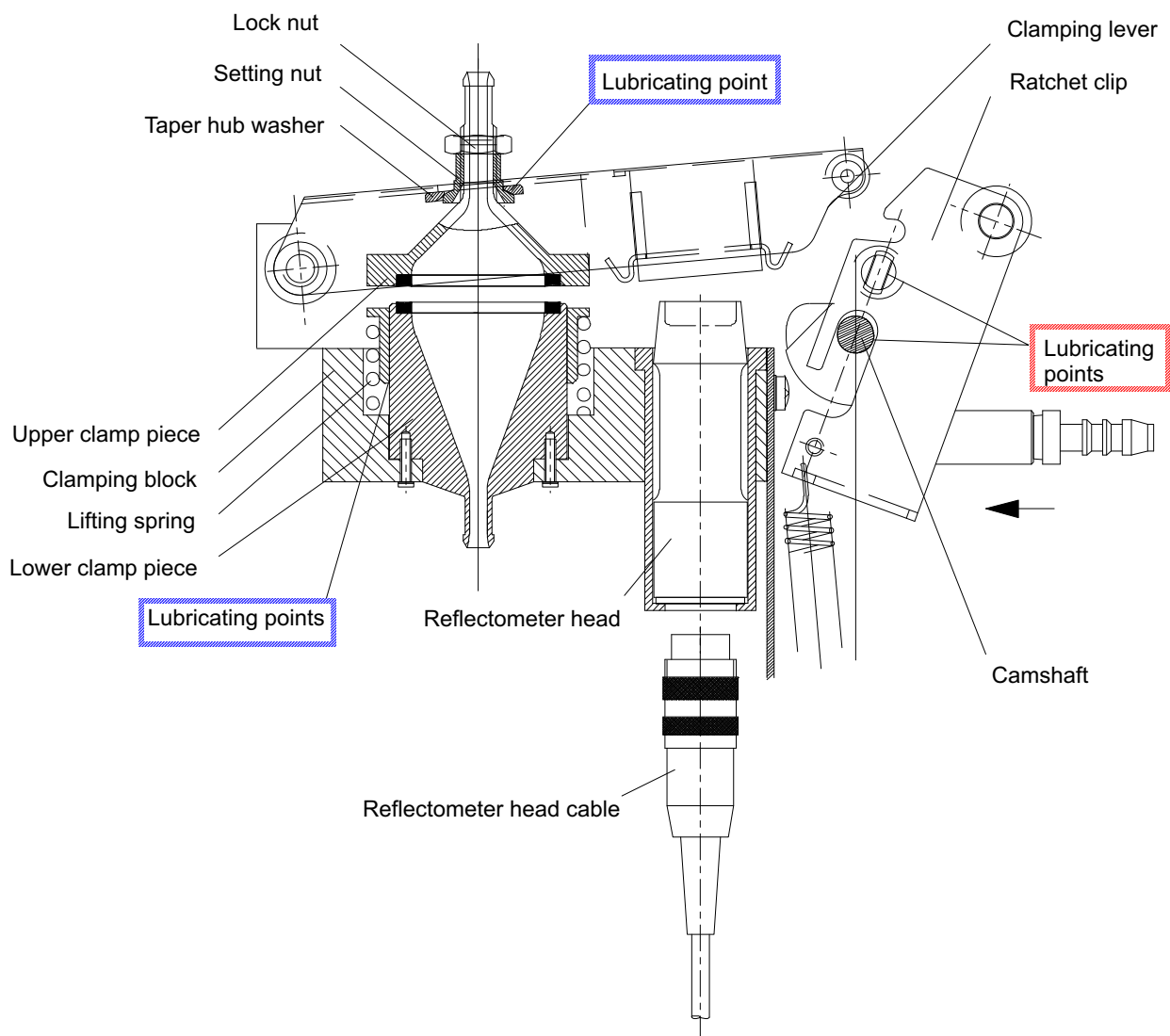


Fig. 1 Lubricating points for camshaft, clamping piece and guides of paper transport roll

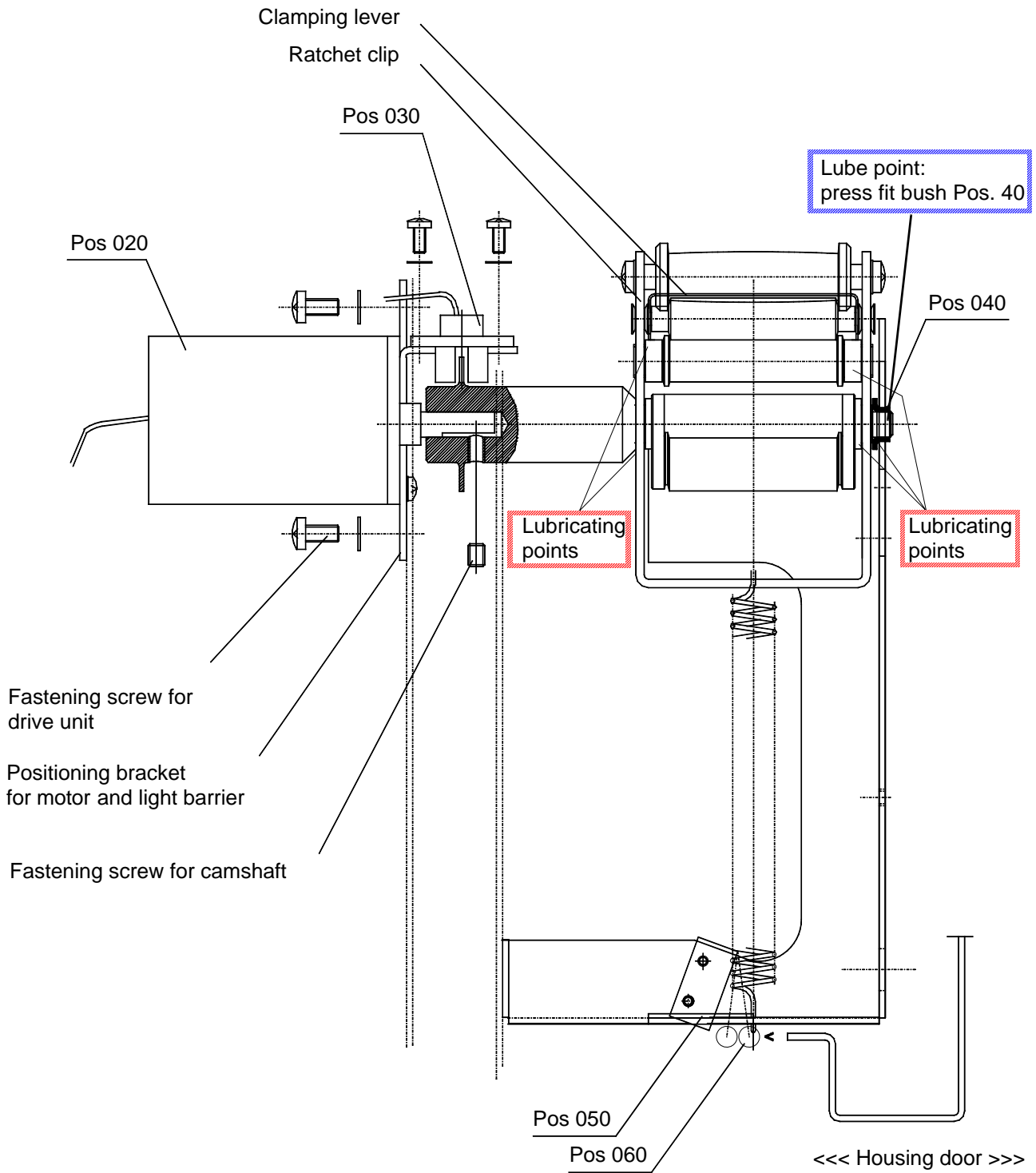
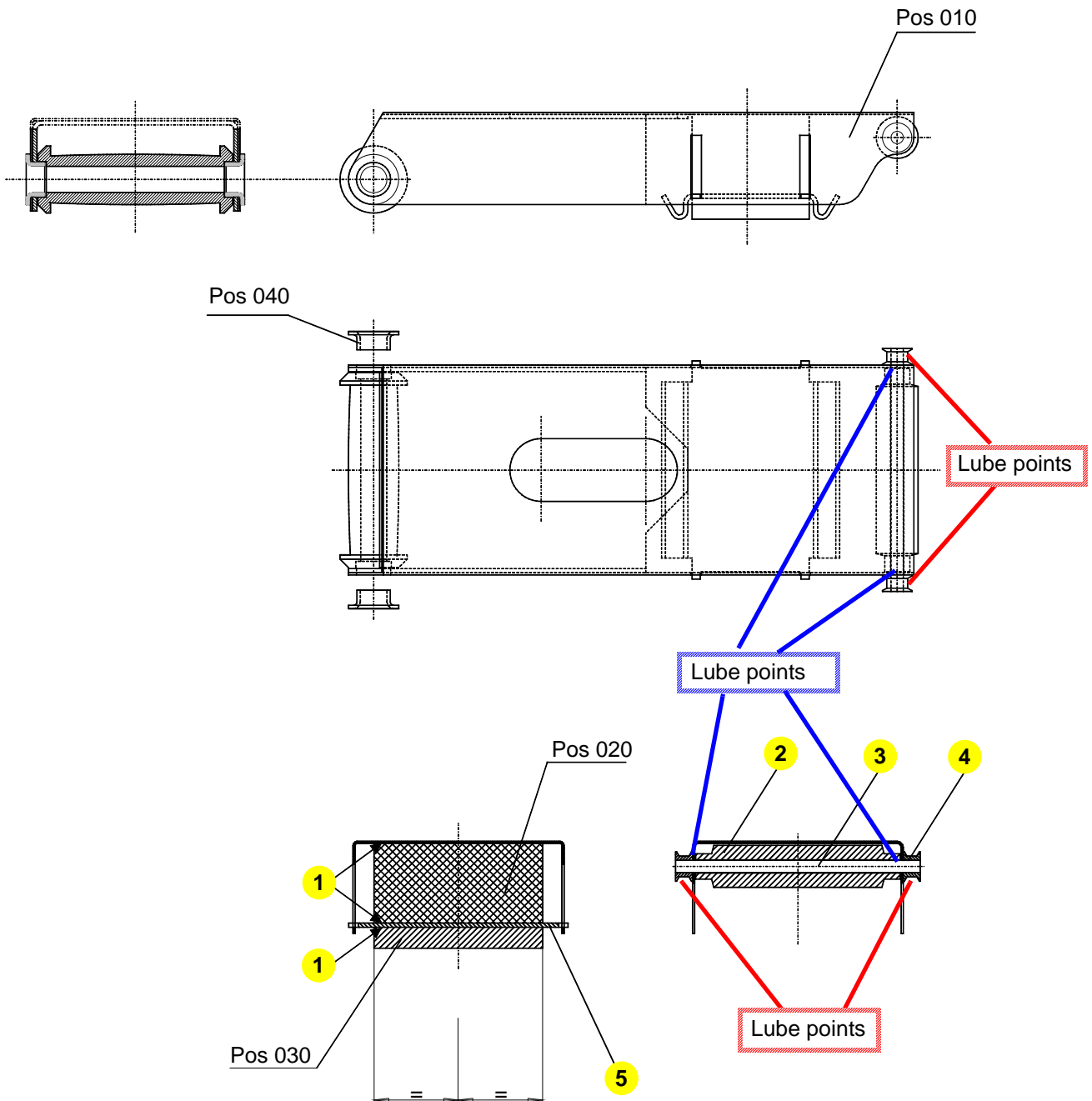


Fig. 2 Lubricating points for camshaft bearing and ratched clip roll



- 1 .....Twin-sided adhesive film
- 2 .....Clamping lever roll
- 3 .....Axis II
- 4 .....Roll I (2x)
- 5 .....White value sheet

Fig. 3 Lubricating points on clamping lever

**Information**

These points on the clamping lever only need to be lubricated "sparingly" approx. every 50 paper rolls.

Please remove any unnecessary or excess oil or grease.

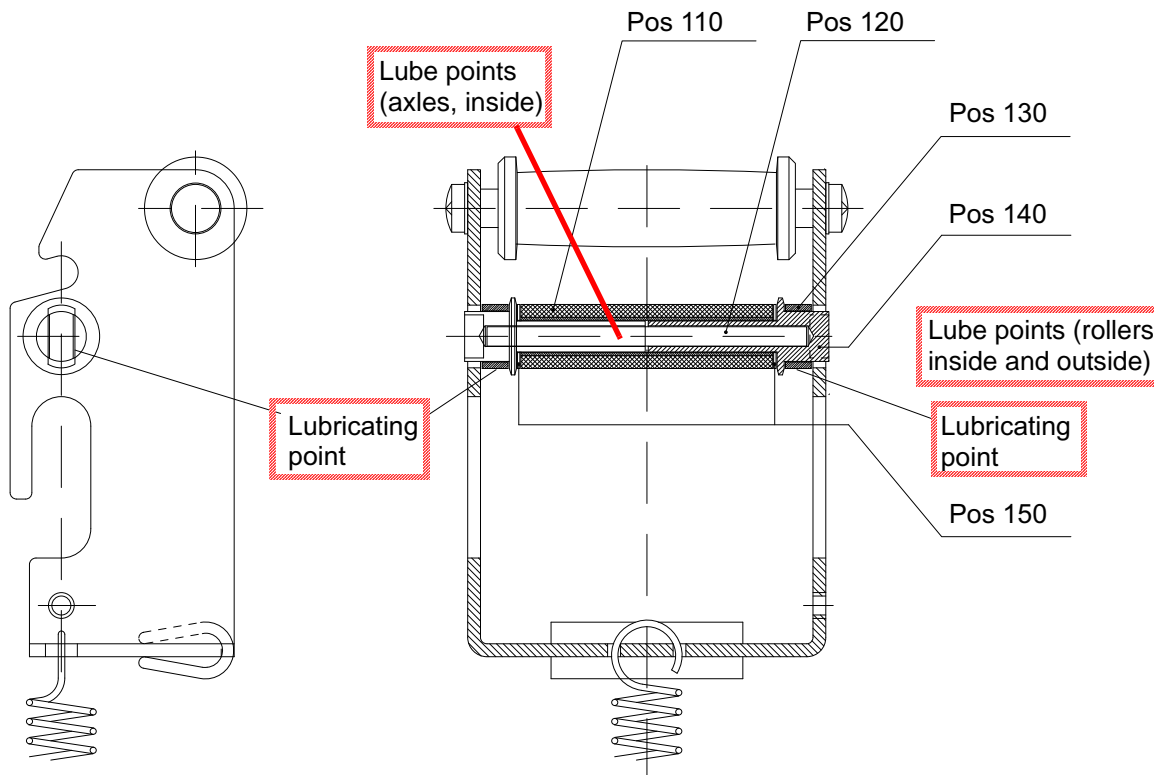


Fig. 4 Lubricating points for ratched clip roll

### 2.3.3 Blackened Filter Area

The filter area must show homogeneous blackening with an exactly delineated, round contour with a diameter of  $29.8 \pm 0.1$  mm.

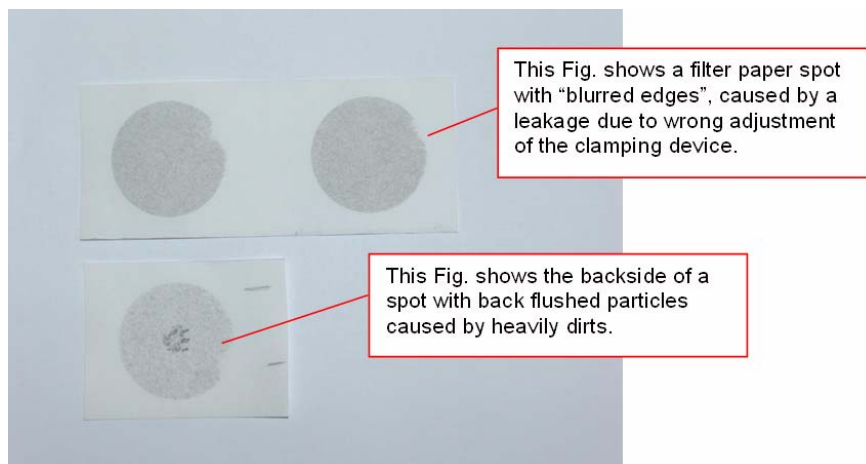


Fig. 5 Blackening of the filter

#### Spots with blurred edges

Blurred edges indicate leaks in the suction unit.

- Check the suction unit (see *Suction Unit* on page 24).

#### Local dark spots

Dark spots indicate the formation of condensate or heavy soot deposits:

1. Check the gas path from the sampling probe to the filter paper.
2. Purge frequently.
3. Reduce the sampling volume and/or use the heating option.
4. Always replace the fine filter.

## 2.3.4 Sampling Probe and Sampling Line

- Leak check**
- Check the thread, sealing surfaces and clamping points of the line fittings and sampling line itself for leaks.

- Check for soot deposits**
1. Clean out the sampling path with cleaned, oil and condensate-free compressed air.

### NOTICE

Disconnect the probe and line from the AVL 415S before cleaning them with compressed air.

Under no circumstances the gas path from upper clamping piece of the suction unit to direction SAMPLE OUT may be pressurised with compressed air (see *Fig. 3 page 27 in the operating manual*).

If compressed air is used to clean the suction unit, the clamping pieces, tube and the  $2/2$  way valves MV3 (and MV4), these valves must be "electrically opened" – this is only possible by switching on the according valve in the service menu using the SERVICE MODE (1 = "SWITCHED ON").

Never apply compressed air in this case, if the filter paper is mounted.

Do not blow pollutants into the ambient air. Dispose of pollutants in accordance with your local regulations.

2. Replace the sampling lines if necessary.

- Sampling probe**
1. Dismantle the exhaust gas sampling probe at least once a year if not more often, depending on use.
  2. Remove soot and other deposits.
  3. Lubricate the thread and clamping points with lead-free anti-sticking agent (e.g. with assembly spray SF01, material number HK0029).

### NOTICE

Apply the paste sparingly so that none gets into the gas path!

#### Sampling probe standard Material number: BO3144SP



*Fig. 6 Sampling probe standard  
(Available in the eSpares™ Webshop)*

- Sampling line**
- In exceptional cases, the surface characteristics of soot deposits may result in reduced measurement value accuracies (because soot is deposited as the gas is drawn through and not blown out completely again during purging).
- Depending on the operating states of the engine and/or the kind of particles, deposits in the hose can develop that cannot be removed using compressed air.
- This deposit can "filter" particles out of the measurement gas and cause measurement deviations.

1. Carry out a reference measurement with a "new" line, if it seems to be necessary.
2. Replace the sampling lines (Viton hoses) regularly.

Recommended replacement intervals: every 1 000 ... 2 000 operating hours.

**The material number depends on the length of the sampling line**



Fig. 7 Sampling line

#### Information

Heavier soot deposits can occur when using new sampling lines for the first time straight from the factory and this can also reduce the recorded FSN values.

The lower the measurement values, the higher, the requirement for repeatability, and reproducibility.

The greater is the influence of the soiling along the entire sampling path.

## 2.3.5 Suction Unit

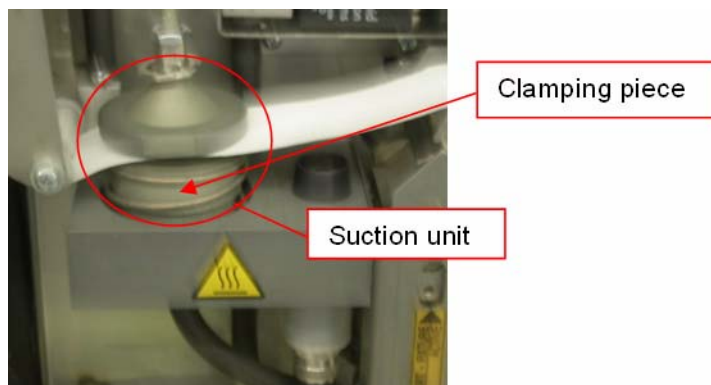


Fig. 8 View of the suction unit in the device

#### Clamp piece tracks

1. Check the friction conditions in the clamp piece tracks.
2. Remove the hose from the upper clamp piece

#### Information

Remember the hose clip when disconnecting and reconnecting the hose.

3. Release the clamping lever and open it completely.
4. Check the clamp piece tracks for easy movement.
5. If necessary, lubricate track (ex-works: Teflon lubricant spray - part number HS0058, Teflon lubricant oil - part number HS0064, or Lubricant grease OKS 260 - part number HS0071)



**NOTICE**

Apply only a thin film of lubrication - only into region between the upper and lower clamping piece (*Fig. 8*), so that no oil can reach the sealing rings.

**Never clean the elastomer parts (sealing rings) in an ultrasonic bath. Replace them only if necessary.**

**Sealing ring**

1. Check the sealing rings for damage or deposits of paper fibres.
2. Remove paper fibres with a soft, damp cloth.
3. Replace sealing rings if damaged.  
Never re-glue used sealing rings.
4. Use only the defined adhesive for glueing the sealing rings.  
Carefully follow the instructions of the glue manufacturer for the usage of the glue.
5. Close the clamping lever (remember the hose clamps).

**CAUTION****Danger of pinching**

Be careful when pressing the paper feed button not to get anything pinched in the clamping mechanism and to avoid defects on the clamping mechanism.

**Gasket 30mm 4152X38./C00.0**  
**Material number: YM3499SP**



*Fig. 9 Sealing ring for suction unit*  
(Available in the eSpares™ Webshop)

**Mounting ring**

We recommend ordering this part for fixing the gasket (material number YM3499SP) into the suction unit of the clamping and drive mechanism:

**Mounting ring 30 mm 4152X41./C00.0**  
**Material number: YM3516SP**



*Fig. 10 Mounting ring 30 mm 4152X41./C00.0*  
(Available in the eSpares™ Webshop)

## Suction unit

**Suction unit 4152W15./C00.0**  
**Material number: BO3774SP**


Fig. 11 Suction unit 4152W15./C00.0  
 (Available in the eSpares™ Webshop)

## Clamping lever adjustment

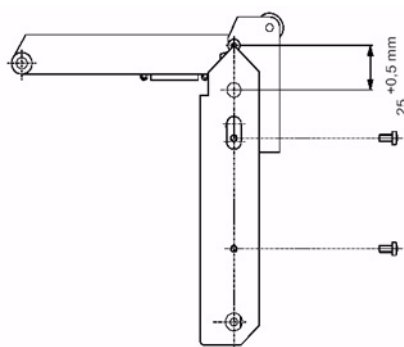


Fig. 12 Clamping lever adjustment

1. Start a paper feed and check that the clearance between the camshaft and the paper transport shaft is  $25 + 0.5$  mm.

If aligned correctly, the tip of the support clip points to the center of the paper transport shaft. You should also be able to press the clamping lever down by 0.5 mm.

2. Adjust if necessary with the setting nut and secure with the lock nut (see Fig. 12 on page 26).
  - If the clearance is too large, the retaining ring does not open wide enough and there is a risk that soot will be scraped off.
  - If the clearance is too small, the leakage factor will be high because the clamping force is insufficient.
3. Check the friction in the tracks/bearings of the ratchet clip-camshaft in relation to one another and:
  - If necessary, lubricate track (ex-works: Teflon lubricant spray - material number HS0058, Teflon lubricant oil - material number HS0064, or Lubricant grease OKS 260 - material number HS0071); see *chapter 13 in the Operating Manual*.

## 2.3.6 Reflectometer Head

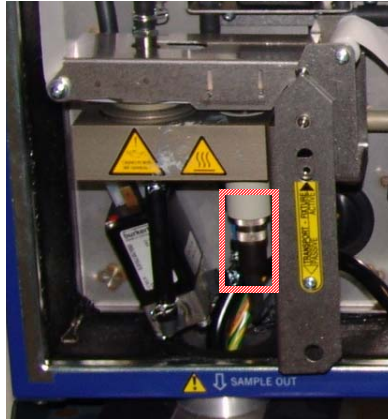


Fig. 13 Reflectometer head

### NOTICE

The blackened surface of the housing (inside) and the transparent optical surfaces of the reflectometer head must never be scratched.

#### Glass area

The glass area on the face must not be soiled, scratched or damaged.

1. Check whether there are any soot deposits or filter paper fibres each time you change the filter paper.
2. Clean the reflectometer head carefully with a puffer and a soft brush, with ultra-pure pressurized air, or replace it.

#### Jacket surface

- Check the blackening of the visible jacket surface of the inside reflectometer head housing between the glass area and the end of the reflectometer head. It must be even (no scratches...).

#### Measuring head

The polymeric material of the measuring head must be clear, transparent and colourless - no colouring is allowed.

- Replace the measuring head, if the polymeric material is coloured yellowish or brownish.

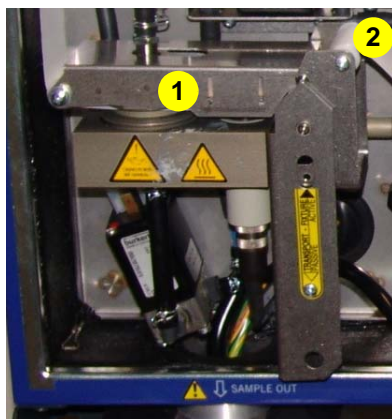
We recommend replacing the reflectometer head every 2 years:

**Meas. head N°1 687 224 606**  
**Material number: EZ0104SP**



Fig. 14 Meas. head N°1 687 224 606 (Available in the eSpares™ Webshop)

## 2.3.7 Clamping Lever and Ratchet Clip



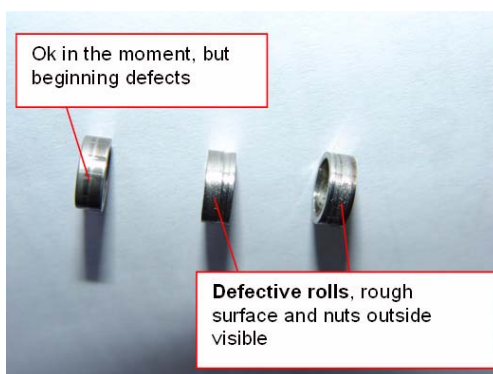
1 .... Clamping lever

2 .... Ratchet clip

*Fig. 15 View of the clamping lever*

- The bearings of the clamping lever itself and of the paper transport shaft must not be worn.
- The flexible transport roll on the paper transport axis of the ratchet clip must not be damaged.
- The foam block must be elastic and the white value plate must press flat against the entire surface of the reflectometer head face when the clamp is closed.

1. Check the surface of the white value plate:  
The surface has to be clean and must not be scratched.
2. Clean with a soft, wet cloth if necessary or replace white value plate.
3. Check the performance of the ratchet clip rolls: the surfaces must be clean, lubricated and the surface shall look as polished - no scratches, cuts, nuts... are allowed (see *Fig. 16* on page 28).



*Fig. 16 Ratchet clip rolls*

4. Otherwise clean all parts of the ratchet clip, replace the ratchet clip rolls, lubricate all moved parts.

### NOTICE

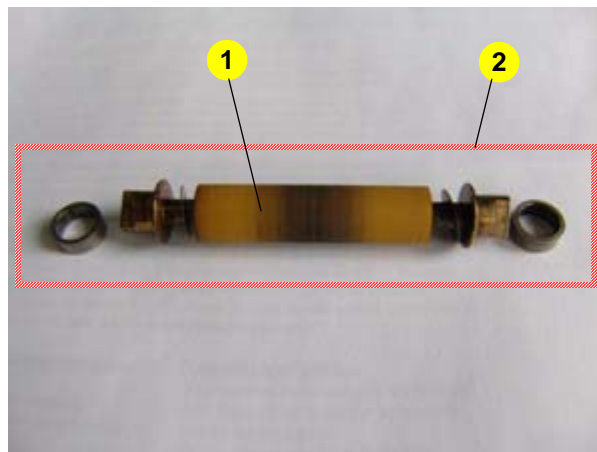
- Never lubricate the elastomer part on the transport roll.  
Remark: a complete exchange of the ratchet clip is recommended.
- Never clean the elastomer part of the transport roll in an ultrasonic bath.  
This part can not be cleaned but only replaced.

**Paper transport roll****Paper transport roll complete**  
**Material number: BW5409**

- Standard transport roll  
Material number: YM3687
- For measurements with high hydrocarbon contents of the particle an alternative transport roll is available:  
Alternative transport roll  
Material number: YM6962.

**NOTICE**

This roll is not recommended as standard transport roll and shall not replace YM3687.



1 .....Transport roll

2 .....Paper transport roll complete

*Fig. 17 Paper transport roll complete*

**Ratchet clip**

We recommend replacing the ratchet clip during the annual preventive maintenance.

**Ratchet clip compl. G002 4152W52**  
**Part Number: BO6671SP**

*Fig. 18 Ratchet clip complete G002 4152W52*  
*(Available in the eSpares™ Webshop)*

**Ratchet clip roll 4152X63./C00.0**  
**Part Number: YM3804**



*Fig. 19 Ratchet clip roll 4152X63./C00.0*  
*(Available in the eSpares™ Webshop)*

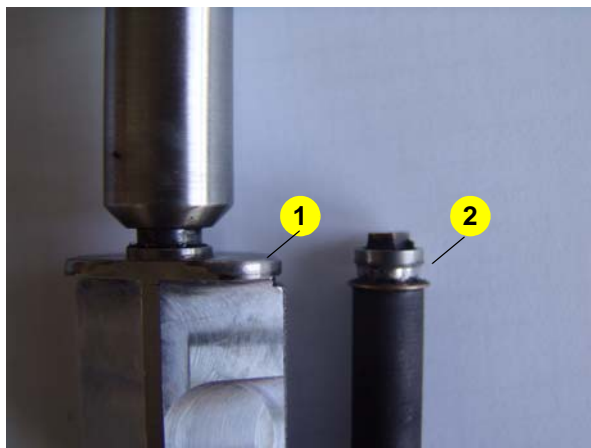
**Clamping lever**

**Clamping lever compl. G002 4152W50**  
**Part Number: BO6439SP**



*Fig. 20 Clamping lever complete G002 4152W50*  
*(Available in the eSpares™ Webshop)*

## 2.3.8 Camshaft



- 1 .... Defective camshaft surface  
 2 .... Defective ratched clip rolls, caused by defective camshaft surface

*Fig. 21 Camshaft*

The camshaft must be replaced if the surface of the tappet is roughened or flattened.

1. Check that the resting position of the camshaft is  $< \pm 10$  deg.
2. Keep in mind that the camshaft bearing in the bearing block must not be chipped.

3. Check that the camshaft is secured on the flattened part of the motor shaft if the camshaft is replaced or was dismantled:

The setscrew in the camshaft must be screwed tight and secured (ex-works: Loctite 245, Part Number HD0016).

4. Lubricate the bearing of camshaft in clamping lever using Teflon lubricant spray (part number HS0058) or Teflon lubricant oil (part number HS0064), or Lubricant grease OKS 260 (material number HS0071) - according to the points indicate on Fig. 22 below.

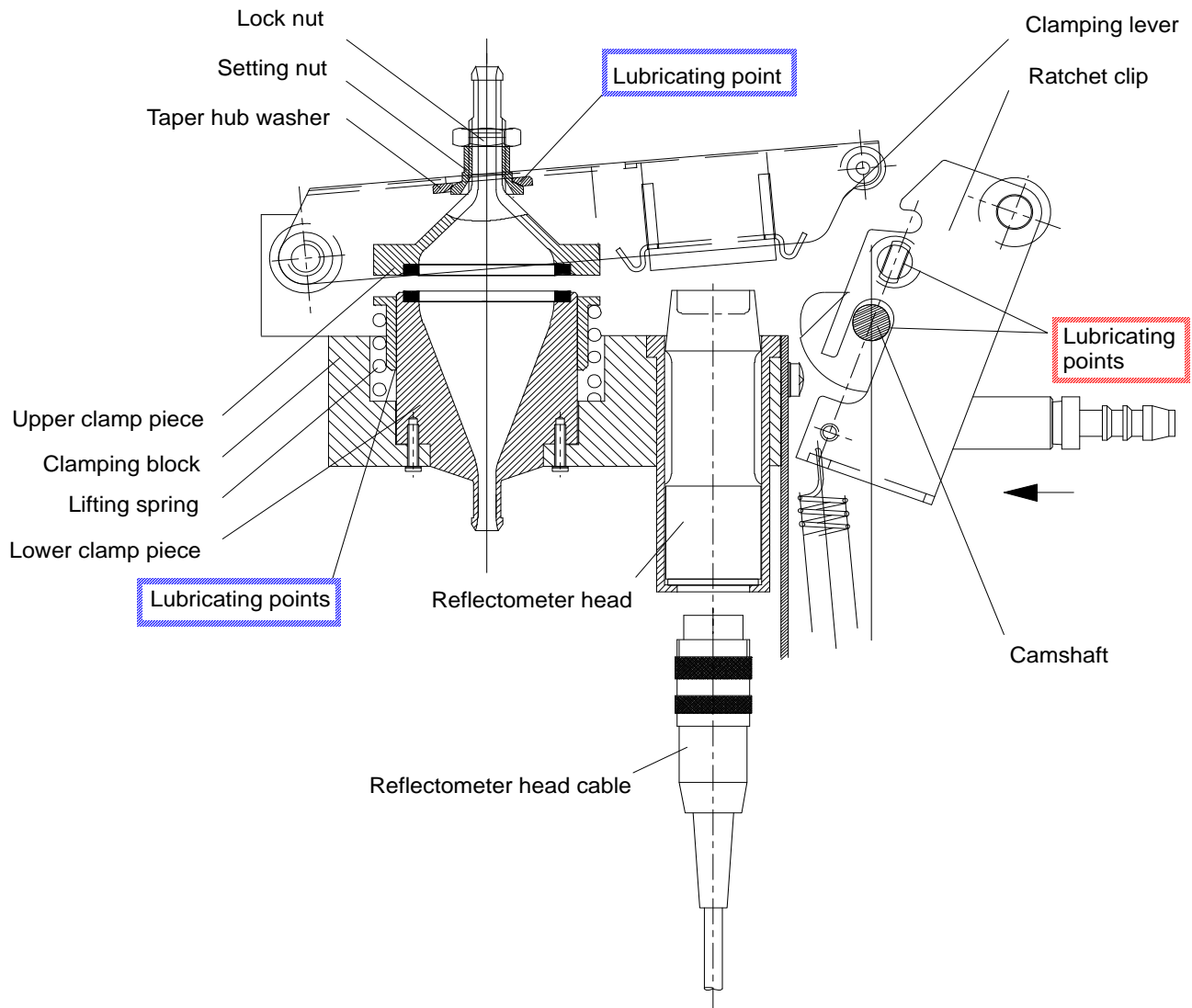


Fig. 22 Lubricating points for camshaft, clamping piece and guides of paper transport roll

### 2.3.9 Fine Filters

- Check the two fine filters every time the filter paper is exchanged.
  - For normal operation:  
We recommend replacing these two fine filters as soon as they become blackened.
  - When high hydrocarbon contents as oil and fuel occur in the exhaust:  
We recommend replacing these two fine filters every time the filter paper is exchanged.

**Fine Filter**

We recommend replacing the fine filters during the annual preventive maintenance:

**Pre-filter**

**Material number: MF0478SP**

**NOTICE**

Remounting the parts, avoid any drilling forces on tubing and upper clamping piece.



Fig. 23 Pre-filter  
(Available in the eSpares™ Webshop)

### 2.3.10 Filter Paper Transport and Spool Device

**CAUTION****Danger of burns and pinching!**

In heated devices there is a danger of burns. The temperature of the components inside a device can reach up to 70°C.

There is a danger of pinching your fingers in the clamp when inserting the filter paper. Be particularly careful!

When working on the filter paper transport and spool, take care not to get your fingers pinched in the chain drive!



Fig. 24 Inside the device, the paper transport mechanism

The spool roll is driven by the supply roll by means of a slip clutch and a chain drive; the driving torque of the spool roll is determined by the pre-tensioning of the compression spring on the supply roll axis:

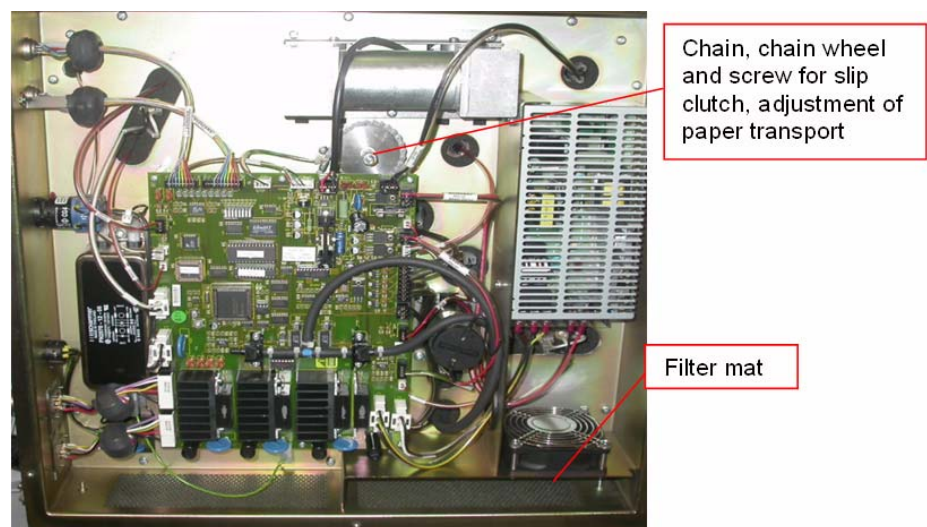


1. Check this function particularly when the supply roll is almost empty and the spool roll full and, if necessary, adjust the pretension of the compression spring accordingly (torque at spool roll 20 to 22 Ncm).

For adjustment, see AT1240 415S Smoke Meter Operating Manual. After adjustment fix it with the counter nut and seal it (see also *Fig. 25* on page 33).

2. Do not pretension the compression spring more than necessary so that the traction force on the filter paper is kept to a minimum.
3. Make sure the roller holder of the used paper spool does not rub against either the supply roller or the paper strip to be spooled onto it.  
The length of a filter paper feed should be between 47 and 53 mm. (tolerances: minimum 43 mm, maximum 57 mm).
4. Do not lubricate chain and chain wheels (in particular the friction surface of the clutch must be "dry", see *Fig. 25*).

### 2.3.11 Cooling



*Fig. 25 View of the filter mat and the paper transport adjustment*

The cooling air flows in and out on the underside of the device through filter mats.

1. Clean the mats with compressed air.
2. Replace heavily soiled mats.

#### Filter Mat

We recommend replacing the filter mat during the annual preventive maintenance:

**Filter mat set 4152W25./C00.0**  
**Material number: BO3899SP**



*Fig. 26 Filter mat set 4152W25./C00.0*  
*(Available in the eSpares™ Webshop)*

## 2.3.12 Pump

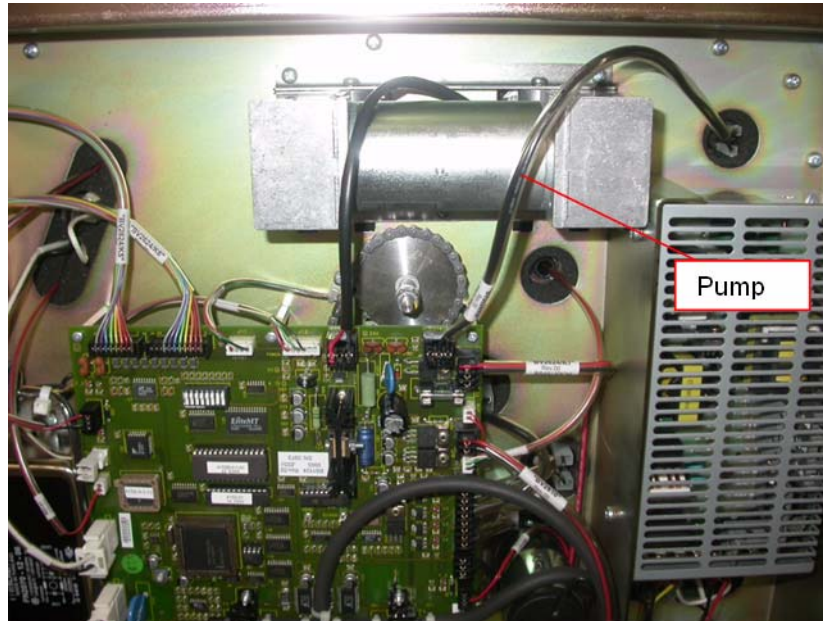


Fig. 27 Back side of the Smoke Meter AVL 415S

### Pump noise

Depending on the application, due to permanent use at automatic tests, pressures at or in the system, pressure pulsations of the exhaust gas, exhaust gas composition and corrosivity of the exhaust gases etc. the pump performance is affected, this can influence the service life time.

1. Check whether the noise of the pump is atypically or whether the pump is very noisy.
2. If yes, exchange the pump or at least check the flow of the pump.

### Pump flow

- Typically the pump flow shall be in a region between 10 ... 13 l/min (if system is heated: up to 15 % lower values related to ambient temperature of 20 °C).
- Test with probe line mounted – maximum 3 m length, clean filter paper inserted, inlets and outlets of the flow are at ambient pressure. Flow measurement at inlet or outlet of the measuring system.
- A simplified pump function check (as well as a check of the flow behaviour in the device) is also possible in the Smoke Meter itself:
- Flow control: no sampling hose or exhaust gas disposal hose is connected.
- The device is already switched on and warmed up or device is switched on in Service mode.

Setting: single measurement, sampling time is set to 120 sec (2 min).

1. Activate a measurement in measurement mode and the device will take in air for 2 min.
2. Switch to the Volume Calibration menu.
  - The sampled volume "Vol 415 at 25 °C/1 bar" should be between 20000 and 26000 ml in unheated operation, which matches a pumping capacity of 10 ... 13 l/min.
  - In heated operation, the measured value range is about 15 % smaller (i.e. approx. 17000 to 23000 ml).

**Information**

- With a sampling line with a maximum length of 3 m connected to MV3 or MV4, the flow rate may be reduced by no more than further 10 %.
- If the Special Sampling Option (Sample Out Box) is installed, the flow rate can also drop by around 10 %.

**Pump components**

1. After about 1 000 operating hours or after 3 months at permanent system usage at automatic tests, clean or replace the orifices, membranes, diaphragms and pump heads.
2. For reassembling the pump, follow the service memo 15/06.

**Diaphragm pump**

We recommend replacing the pump every 2 000 to 3 000 operating hours:

**Diaphragm pump type 7015ZV/24VDC**  
**Material number: MV0207SP**



Fig. 28 Diaphragm pump type 7015ZV/24VDC  
 (Available in the eSpares™ Webshop)

**2.3.13 Pressure Reduction**

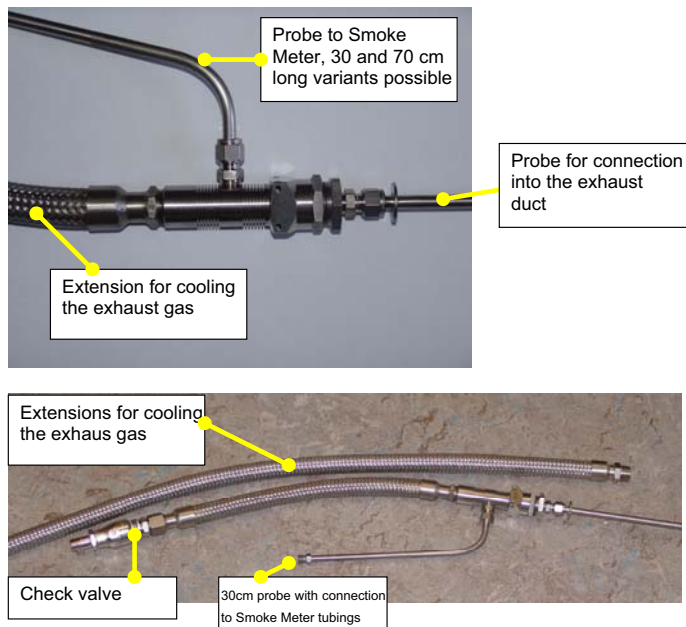


Fig. 29 Pressure Reduction Unit

**Pressure Reduction**

- Clean the unit once per month with compressed air.

**Check Valve**

1. Regularly clean/replace one check valve in rotation with the other one.
2. Replace the check valves once a year.
3. Perform a visual check after every assembly and at least once per week.

## 3 Checks

### 3.1 Sampling Volume Check

This function is used to compare the amount of the sampling volume with an external measurement system.

This check can be performed:

- with AVL 4210 Instrument Controller; see *Sampling Volume Check with AVL 4210 Instrument Controller* on page 37.
- via terminal; see section *Sampling Volume Check via Terminal* on page 38.
- via device user interface DUI; see *AVL 415SE Smoke Meter Calibration, User's Guide (material number AT3803)*.

#### Information

In heated devices, the calibration should be carried out when the device is heated. For this you need the Retrofit Kit (material number: BO3776). Remark: this is a standard part of the AVL 408S Volume Tester, if delivered after 1. Jan 2000.

Measurement device and volume tester have to be operated at ambient pressure which has to be parameterized.

This check shall be performed at stable thermal conditions, e.g. heated devices should be heated completely with closed front door.

#### 3.1.1 Sampling Volume Check with AVL 4210 Instrument Controller

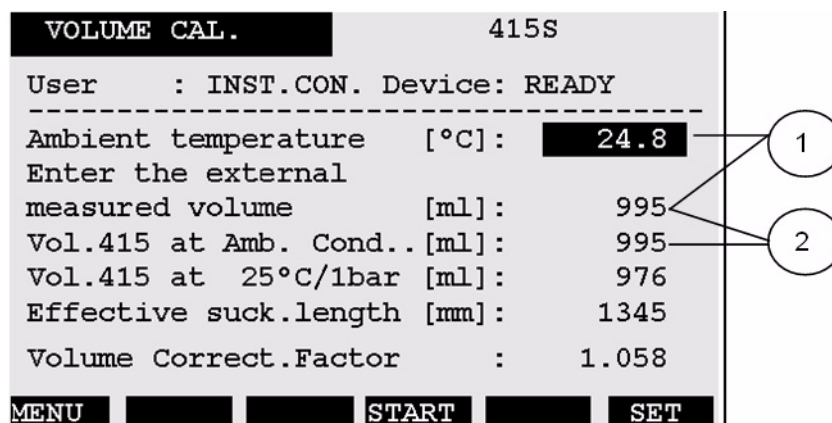


Fig. 30 Sampling volume check with AVL 4210

1. Enter measurement values.
2. Compare measurement values.

Connect your external measuring equipment to the SAMPLE 1 IN input.

1. Press **START** on the AVL 4210 to initiate a filter paper feed and zeroing of the pressure sensors. (The system is not under pressure and there is no flow. The instantaneous differential and relative pressure signals are assigned the value 0).
  - The prevailing ambient pressure is entered under the calibration parameters.
  - The parameterized nominal volume (which in manual mode has to be set in the measurement parameters) is drawn in and the sampled volume displayed.
2. Enter the prevailing externally measured ambient temperature (at the external reference instrument) and the externally measured volume. The volume measured by the AVL 415S is recalculated for these ambient conditions.
3. Now compare the volume measured by the AVL 415S (displayed on the AVL 4210) with the volume measured by the external equipment.
4. If the values differ by more than 3 %, save the correction factor in the AVL 415S by pressing **SAVE** on the AVL 4210.

#### Information

The new correction factor shall be in the interval 0.7 ... 1.3.

If the new correction factor is less than 0.7 or greater than 1.3, check the metering pipe (see *Metering pipe* on page 40).

Precision of calibration: typical approx.  $\pm 10$  ml or better.

## 3.1.2 Sampling Volume Check via Terminal

### Command sequence

**SREM**

1. Switch AVL 415S to REMOTE MODE

**SVOP**

2. Start volume check.

**AVKF V T**

3. Query command for volume correction factor

Important: both parameters **V** and **T** must be specified!

**V** ... externally measured volume [ml]

**T** ... externally measured ambient temperature [°C]

Response:

**AVKF V<sub>e</sub> V<sub>i</sub> VKF**

**V<sub>e</sub>** ... externally measured volume [ml]  
(same as first input datum)

**V<sub>i</sub>** ... internally measured volume [ml]  
referred to parameterized ambient pressure and input ambient temperature

**VKF** ... recalculated volume correction factor [-]  
(3 decimal places)

## Command sequence

4. If both volumes differ around more than 3 %, save the new calculated volume correction factor (only possible when data backup deactivated, see *AVL 415S Smoke Meter, Operating Manual, chapter Data Backup*).
- SKOR**
5. Depending on your software version, continue as follows:
    - For software versions higher than 1.03 use the **SKOR** command - the newly calculated volume correction factor is saved to the calibration parameter set.
    - For software versions up to 1.03 proceed as follows:
- ACPA**
6. Query calibration parameters.
  7. Write down the values of date 1 to date 3:
    - 1st date: dead volume (sampling line 1) [ml]
    - 2nd date: dead volume (sampling line 2), for two-channel measurement [ml]
    - 3rd date: ambient pressure [mbar]
    - (4th date: old volume correction factor [-])
- ECPA T<sub>1</sub> T<sub>2</sub> P<sub>u</sub> VKF**
8. Set calibration parameters:
    - 1st date: dead volume (sampling line 1) [ml]
    - 2nd date: dead volume (sampling line 2), for two-channel measurement [ml]
    - 3rd date: ambient pressure [mbar]
    - 4th date: *new* volume correction factor
  9. Depending on the protocol used, enter the newly calculated volume correction factor as follows:
    - AK protocol:  
as displayed by command **AVKF**  
(with three decimal places, e.g. 1.090)
    - 415-compatible protocol:  
multiply value display by command **AVKF** by 1000  
(no decimal places, e.g. 1090)

### 3.1.3 Check the Metering Pipe

If the new correction factor is less than 0.7 or greater than 1.3, the Smoke Meter needs a service.

To make access easier when dismantling:

1. Unlock the clamping lever by opening the ratchet clip.
2. Press the ratchet clip upwards against the tension spring and remove to the right.

Part of the metering pipe is integrated in the clamping block which is extended by the screwed-on orifice pipe.

3. Remove the orifice pipe (fastened to the clamping block by two screws).  
Be careful – the orifice plate and O-rings might fall out!
4. Clean the parts carefully, especially the orifice in the plate.
5. Reassemble as shown below noting the direction of the orifice bore taper!
6. Insert the ratchet clip on tension spring and close the clamping lever.

#### Information

After reassembly, a new leak check must be carried out and the volume correction factor needs to be determined again!

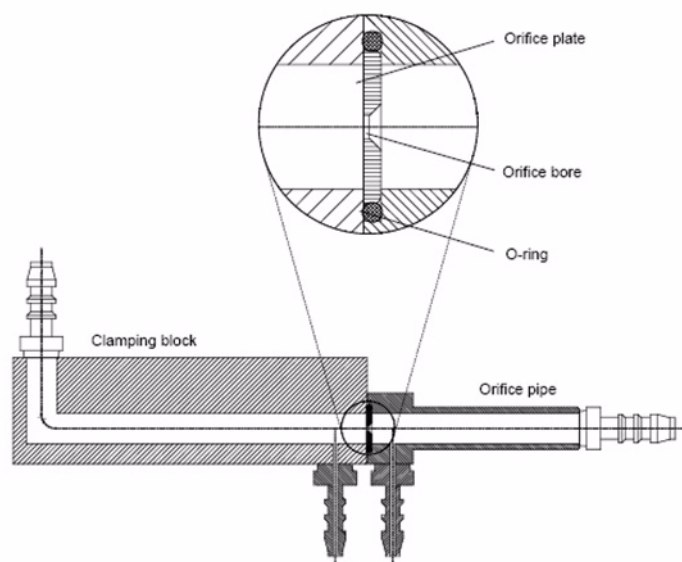


Fig. 31 Metering pipe

### 3.1.4 Examples of External Volume Measuring Systems

- AVL Volume Tester
- Dry gas meter (for a flow measurement range of 8 ... 16 l/min)

AVL Volume  
Tester

Material number: GH0326SP  
Material number: TM0415VOLA.01  
(GH0326 incl. Deconnex Fluid No. 11 HC0013)

#### Information

Delivery restriction may be possible, security data sheet (MSDS) ist available.



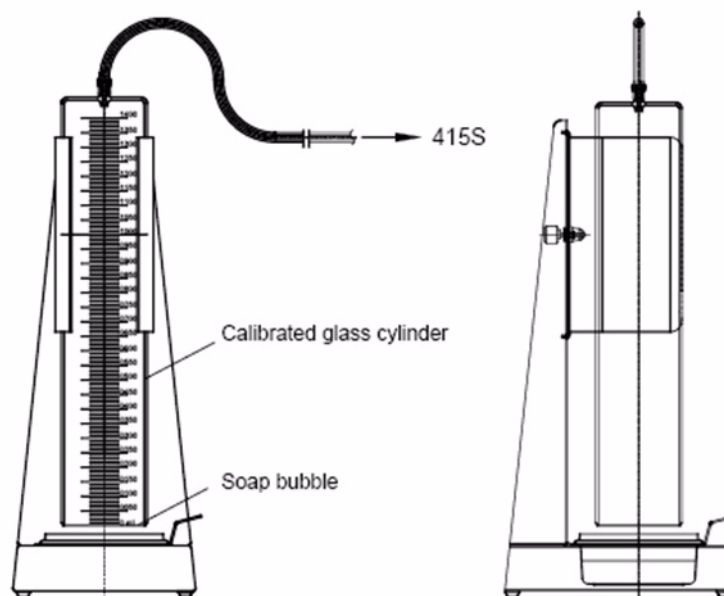


Fig. 32 Volume tester 408S for 415

The sampling volume (at ambient pressure and ambient temperature) can be measured highly accurately with this method and virtually loss-free.

The Tester is used to check the volume of a sampling volume of 1000 ml. The nominal volume has to be set to 1000 ml.

A read-off accuracy of  $\leq 1 \text{ mm} = 4 \text{ ml}$  or 0.4 % is possible.

#### Dry Gas Meter

##### Information

An officially calibrated dry gas meter can only deliver measurement accuracy better than 1% when the flow is continuous.

To minimize the effect of the error that occurs at the start and at the end of the measurement (i.e. when flow builds up and diminishes), we recommend carrying out the volume check with a nominal volume of 20 000 ml.

## 3.2 Leak Check

This function is used purely to check for leaks in the Smoke Meter's gas path.

##### Information

When using the Special Sampling Option always perform the leak check in SERVICE MODE, otherwise in standard leak check the error "Leakage extremely high" is output.

- Press **START** on the AVL 4210 Instrument Controller or enter command **SLEC** from the terminal to start the leak check:
  - The system initiates a paper feed and zero calibration of the pressure sensors.
  - It switches to SAMPLING MODE and solenoid valve MV3 remains closed.
  - The leak check is completed when "Ready" is displayed again on the AVL 4210 or, when the text **SRDY** is returned in response to the **ASTZ** status query command via the terminal.

- The Smoke Meter has passed the leak check if the leakage is less than  $1.5 \text{ ml}/(100 \text{ mbar} \cdot \text{s})$

### Information

1. For Smoke Meter systems with "mounted versions" of the option high pressure, and tests via the service mode add  $1 \text{ ml}/(100 \text{ mbar} \cdot \text{s})$  to the above limits (this is not checked by the software automatically).
  - If the "**FUNCTION TIMEOUT**" or the "**LEAKAGE EXTREMELY HIGH**" error is displayed on the AVL 4210 (or error **10** or **101** is output at the terminal), it could not set up the required low pressure within 5 s (i.e. extreme leak).
  - If the "**LEAK CHECK NOT SUCCESSFULL**" error is displayed on the AVL 4210, the leakage is greater than the allowed limit (for limits: see *above*)
  - The actual measured value is displayed (see *Fig. 33* on page 42)  
For example:  $0.8 \text{ ml}/(100 \text{ mbar} \cdot \text{s})$   
The pressure is not checked during a leak check; no related error messages are therefore output.
2. Use the AK command **AIDA** to display the leak factor in TERMINAL MODE.

```

LEAK CHECK                               415S
User   : INST.CON. Device: READY
-----
Leakage [ml / 100mbar * s]:              0.8

MENU  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]
START [ ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]  [ ]

```

Fig. 33 Leak check

### 3.2.1 Leak Check in SERVICE MODE (for Firmware Version 1.10 and Higher)

When this function is started in SERVICE MODE, the leak test is carried out with the smoke valve open (MV3 or MV4, set of sample 1 or 2 in the "Measurement" screen when the Two-Channel Measurement Option are installed).

SERVICE MODE is activated by pressing and holding down the paper feed key when switching on the AVL 415S. Error monitoring is disabled in SERVICE MODE. To quit SERVICE MODE switch the device off and on again.

1. Remove the probe from the sampling site and close it off.
2. Activate the leak check.
3. Detect any leaks in the sampling hose and screwed connections if needed.
4. After that switch the device off briefly and then on again to terminate SERVICE MODE. That ensures that any error messages that occur are not ignored.

## 4 Parts Lists

### Information

All the consumables, wear parts and spare parts apart from the set of fittings (Material Number TM0415SFIT.01) are available in the Webshop.

\* These are spare parts considered as "CRITICAL PARTS". The exchange has to be done by an AVL Service engineer.

### 4.1 Consumables

Designation	Material Number	Sales Unit
Filter Paper Roll 597LA 200 m	HP0153SP	PCK 10
Pre-Filter	MF0478SP	PCK 5
Teflon Lubricant Oil 50 ml	HS0064	PCS

Tab. 3

### 4.2 Wear Parts

Designation	Material Number	Sales Unit
Washer Din 988 5 x1 0 x 0.2	DZ0655SP	PCK 100
Tube 6.0 x 2.0 Viton Black	SS0272SP	PCK 15
Tube 4.0 x 2.0 Viton Black	SS0271SP	PCK 15
Hose Nipple 415X32./C00.0	YM3493SP	PCK 10
Gasket 30 mm 4152X38./C00.0	YM3499SP	PCK 5
IC-MEM 48T02 Zerop.Ram/Timer	EE0336SP	PCS
Adhesive 3M-B20	HK0056	PCS
Set of Fittings	TM0415SFIT.01	PCS
Hose Set 415S 4152x29./C00.0	BO3583SP	PCS
O-Ring 10.0 x 1.5	DA0375SP	PCK 10
O-Ring 2.5 x 1.6	DA0195SP	PCK 10
Fuse Slow-Blow 3.15 A 250 V	EV0047SP	PCK 50

Tab. 4

## 4.3 Spare Parts

Designation		Material Number	Sales Unit
Transport Roll		YM3687	PCS
Damper 1	4152W03./C00.0	MY0163	PCS
Damper 2	4152W04./C00.0	MY0164	PCS
Bearing Bush	4152X33./C00.0	YM3494	PCS
Ratchet Clip Roll	4152X63./C00.0	YM3804	PCS
Ratchet Clip Shaft	4152X61./C00.0	YM3802	PCS
Roll Holder 130	4152U26./C00D1	ZG2456	PCS
Roll Holder 250	4152U14./C00.0	ZG2374	PCS
Cable Power/Error	4152V09./C00.0	BV2243	PCS
Cable Sample 230V G002	4152V44./C00.0	BV2625	PCS
Cable Sample 100/115V	4152V45./C00.0	BV2626	PCS
Cable Heating Orifice	4152V26./C00.0	BV2340	PCS
Cable Heating Orifice 100/115 VAC	4152V27./C00.0	BV4369	PCS
Cable Heating Dev. 230 VAC		BV2341SP	PCS
Cable Heating Dev. 115 VAC	4152V29./C00.0	BV2344	PCS
Set of Cables 2	4152V43./C00.0	BV2624	PCS
Pl. Connection Cover Cap for Cable Sockets		EU1459	PCS
Mains Supply Filter 230V 12A		EI0297	PCS
Pl. Connection 3P Built-In Mains Plug		EU0013	PCS
Pl. Connection Cover Cap for Appl. Plug		EU0339	PCS
Pl. Connection Cover Cap for Appl. Socket		EU2031	PCS
Varistor Module	4152.80./C00.0	BO3613	PCS
Push Button, 1xS, 250 V/1 A, Grey		ES0419	PCS
Supplementary Equipment Set	4080W01./C00.0	BO3776	PCS
Fuse 1,6 A 250 V		EV0044	PCS
Screw Cap 409.08.02		YM0847SP	PCS
Measuring Head No. 1 687 224 606		EZ0104SP	PCS
Press Fit Bush (Bear.-Clamp.Lever Unit)		DL0066SP	PCK 2
Pressure Sensor 26PCCFA1D +/-1.034 bar		EZ0157SP	PCS
Display Board	4070L01./C00.0	BB0429SP	PCS
Suction Unit	4152W15./C00.0	BO3774SP	PCS
Solenoid Valve 2/2-W G1/8" DN=4 1.8 bar		MM0623SP	PCS
Solenoid Valve 3/2-W G1/8 DN2.4 1.8 bar		MM0624SP	PCS
Diaphragm Pump Type 7015ZV/24 VDC		MV0207SP	PCS
Orifice	4152X02./C00.0	YM3433SP	PCS
Holder White Valve	4070S10./R34.0	YM2039SP	PCK 5
White Lever Panel complete	4152X28./C00.0	BO3582SP	PCS
Clutch Disc D=45,D=18	4152X47./C00.0	YM3566SP	PCK 10
Straight Connection SO 21121-6-1/8		DN1469SP	PCK 5
Kink Protection (Sampling Line)		EP0377SP	PCK 5

Designation		Material Number	Sales Unit
Sampling Probe 415 Straight	4152W05./C00.0	BO3144SP	PCS
Sampling Probe 415 Long	4152W30./C00.0	BO4260SP	PCS
Sampling Pipe 415	4152X11./C00.0	YM3476SP	PCS
Screw Connection (Male) FBZ8-3/8-SS-BT		DN1456SP	PCS
Sample Line 1M	4152W06./C00.0	BO3145SP	PCS
Sample Line 1.5M	4152W31./C00.0	BO4309SP	PCS
Sample Line 2M	4152W07./C00.0	BO3410SP	PCS
Sample Line 3M	4152W08./C00.0	BO3411SP	PCS
Sample Line 5M	4152W09./C00.0	BO3412SP	PCS
Sample Line 7M	4152W23./C00.0	BO3782SP	PCS
Sample Line 8M	4152W10./C00.0	BO3413SP	PCS
Cable MOTOR	4152V42./C00.0	BV2610SP	PCS
Controller 415S	4152L02./C00.0	BB1124SP	PCS
Power Supply 24 V/4.2 A 100 W 85-264 VAC		EN0406SP	PCS
Temperature Sensor incl. Cable		BV2339SP	PCS
Light Gate1	4152V23./C00.0	BV2337SP *	PCS
Light Gate 2	4152V24./C00.0	BV2338SP	PCS
Cable FAN	4152V28./C00.0	BV2342SP	PCS
Fuse,1 A, 250 V, Super Time Lag		EV0192SP	PCK 10
Fuse 5 A Slow 250 V		EV0050SP	PCK 10
Micro Switch complete	4152W33./C00.0	BH0225SP	PCS
Micro Switch Activator w. Roll		ES0402SP	PCK 2
Power LED N012.01./B07.0		BB1064SP	PCS
Mounting Ring 30 mm	4152X41./C00.0	YM3516SP	PCS
Spare Parts Set for Pump 7015		MV0143SP	PCS
Welding Piece 6-6GW		DN1324SP	PCS
Closing Plug NPT-3/8		DN1373SP	PCS
PC-Interface Cable	4152V34./C00.0	BV2395SP	PCS
Supply Cable 230 VAC	4390V01./C00.0	BV2166SP	PCS
Supply Cable 100/115 VAC	4390V31./C00.0	BV2261SP	PCS
Connecting Cable (15 m) for IC 4210		BV2191SP	PCS
Connecting Cable (20 m) for IC 4210	4390V55./C00.0	BV2467SP	PCS
415-High Pressure	4152L03	BB1262SP	PCS
Glass Cylinder 408 complete	4080.01./C00.0	BO1608SP	PCS
Filter Mat Set	4152W25./C00.0	BO3899SP	PCS
Sample In Box 1 complete	4152W46	BO6275SP	PCS
Sample In Box 2 complete	4152W47	BO6276SP	PCS
Sample Out Box complete	4152W48	BO6277SP	PCS
Clamping Lever complete G002	4152W50	BO6439SP	PCS
Ratchet Clip complete G002	4152W52	BO6671SP	PCS
Print Connection 1	4152V49AR	BV2838SP	PCS
Print Connection 2	4152V50ARD	BV2839SP	PCS
Connecting Cable 5-Pin	4152V51	BV2840SP	PCS

Designation		Material Number	Sales Unit
Connecting Cable 7-Pin	4152V52	BV2841SP	PCS
Cable Measuring Head	4152V58	BV2900SP	PCS
T-Piece TS6		DN0812SP	PCK 10
T-Piece TS4		DN0813SP	PCK 10
T-Muff Screw Connection (Male) TES6/R1/8		DN0815SP	PCK 10
Angle Muff Screw Connection (Male) WES/6R1/8		DN0816SP	PCK 10
Straight Muff Screw Connection (Male) GES4R1/8		DN1448SP	PCK 10
Straight Muff Screw Connection (Male) GES6/R1/8		DN0811SP	PCK 10
Socket 5056-09		DN1332SP	PCS
Coupling Plug 5150-1/8		DN2161SP	PCS
Screw Plug S2610-1/8		DN2165SP	PCS
Safety Guard for Fan		EI0359SP	PCS
Glow Lamp Green 110 V (Status Lamp)		EL0325SP	PCS
Power Supply 24 V/6,3 A 150 W 85-264 VAC		EN0406SP	PCS
Relais-Power 4U 24VG 1500 VA 250 V 6 A		ER0242SP	PCS
Main Switch 2K 380 V/10 A		ES0360SP *	PCS
Micro Switch, Front Door		ES0400SP	PCK 2
Fuse 200MA Flink 250 V		EV0055SP	PCK 10
Temp. Click 80 °C Self Reset		EV0245SP	PCS
Temp. Click 150 °C Self Reset		EV0246SP	PCS
Temp. Click 120 °C Mech. Reset		EV0247SP	PCS
2/2-Way-Valve		MM0956SP	PCS
Muffler Filter 2941-1/8"		MY0162SP	PCK 10
Tube 4.0 x 1.0 Teflon 9 bar/150 °C		SS0265SP	PCK 10
Insulating Mat (Heated)		YM3446SP	PCS
Metal Hose NW = 5 L = 500	4152W49	YM4256SP	PCS
Gasket	409.01.18	DN0061SP	PCK 10
Lock Nut		YM1863	
Taper Disk		YM1864	
Hose Nippel with Nut for 415S G01, G02 and 415SE (Stainless Steel)		YM3493	
Hose Nippel with Nut for 415S G02 and 415SE (Stainless Steel)		YM7144	
Option Pressure Reduction			
Screw Connection Probe Head		DN1564	
Back Pressure Valve		MM1254	
Metal Hose (Extension 1 m)		YM6126	
Probe Head Short, 30 cm		YM6168	
Probe Head Long, 70 cm		YM6169	
Thermo Click 95 °C		EV0467	

## 4.4 Maintenance Tools

Designation	Material Number
Mounting Spray SF01	HK0029
Loctite 222	HD0005
Loctite 577	HD0014
Loctite 245	HD0016
Adhesive 3M-B20	HK0056
Spray Adhesive 3M-90/500 ml	HK0057
Reflectance Standards 415	BO1941
Volume Tester 408S	GH0326SP
Soap Concentrate	HC0013
Teflon Lubricant Spray	HS0058
Teflon Lubricant Oil 50 ml	HS0064
Lubricant Grease OKS 260	HS0071

Tab. 6







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