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## 1 Introduction

### 1.1 Scope and Purpose

This repair shop manual is intended to support familiarised personnel in the repair of the air heaters Air Top 3500, Air Top 3500 Volume Plus and Air Top 5000 of the Diesel type.

#### 1.1.1 Use of the Air Heaters

The air heaters Air Top 3500 and Air Top 5000 are used to

- heat the cabin
- defrost the windscreens
- heat the goods in transport

They are not cleared to be used for heating a compartment intended for the transportation of dangerous goods.

The heaters work independently from the vehicle engine and are connected to the vehicle's fuel and electrical system. The use in vehicles with water or air cooled engine is possible.

### 1.2 Meaning of Warnings, Cautions, and Notes

WARNINGS, CAUTIONS, and NOTES in this manual have the following meaning:

#### WARNING

This heading is used to highlight that non-compliance with instructions or procedures may cause injuries or lethal accidents to personnel.

#### CAUTION

This heading is used to highlight that non-compliance with instructions or procedures may cause damage to equipment.

#### NOTE

This heading is used to highlight and draw specific attention to information.

### 1.3 Additional Documentation to be used

This workshop manual contains all information and procedures necessary for the repair of air heaters Air Top 3500 and Air Top 5000. The use of additional documentation is normally not necessary. Operating instructions/installation instructions and the vehicle specific installation proposal may be used as complementary information as necessary.

## 1.4 Safety Information and Regulations

The general safety regulations for the prevention of accidents and the relevant operating safety instructions have to be observed at all times.

"General Safety Regulations" beyond the scope of these regulations are detailed in the following.

The specific safety regulations applicable to this manual are highlighted in the individual chapters by Warnings, Cautions, and Notes.

### 1.4.1 General Safety Notes

Within the scope of the StVZO (Road Traffic Licensing Regulations of the Federal Republic of Germany) "Design General Approvals" laid down by the Federal Office for Motor Traffic exist for the Air Heaters Air Top 3500 and Air Top 5000 with the following official marks of conformity:

- ~S306 for Air Top 3500 (Diesel)
- ~S303 for Air Top 5000 (Diesel)

Installation of the heater is to be performed in accordance with the installation instructions and must be checked in case of

- a) the vehicle type inspection in accordance with § 20 StVZO
- b) the individual inspection in accordance with § 21 StVZO or
- c) The examination in accordance with § 19 StVZO performed by an officially authorised expert or examiner for road traffic, a vehicle inspector or a public servant as per section 7.4 a of Annex VIII to the StVZO.

In the event of c) the installation must be certified on the acceptance certificate included in the copy of the "General Operating License" giving details about

- manufacturer
- type of vehicle and
- vehicle identification number.

This validates the "Design General Approval".

**The acceptance certificate must be kept with the vehicle. The year of initial operation must be durably marked on the identification plate.**

The heaters are cleared for heating the passenger and driver cabin, but not for heating a compartment intended for the transportation of dangerous goods.

When using the heater in special vehicles (e.g. vehicles for the transportation of dangerous goods ADR) or in vehicles not subject to the Road Licensing Regulations (StVZO) (e.g. ships), the applicable partially regional regulations must be observed.

When installing the Air Top 3500 and Air Top 5000 in vehicles intended for the transportation of dangerous goods, the TRS 002 and TRS 003 (Technical Guidelines for Regulations concerning the transportation of dangerous goods on roads) must be met in addition to the StVZO (Road Traffic Licensing Regulations).

The heater must not be installed in the passenger or driver cabin of busses. Should the heater nevertheless be installed in such a compartment, the installation box must be sealed tight against the vehicle interior. There must be sufficient ventilation of the installation box from the exterior in order not to exceed a maximum temperature of 40 °C in the installation box. Excessive temperatures may cause malfunctions.

**At filling stations and fuel depots the heater must be switched off as there is a potential danger of explosion.**

**Where flammable fumes or dust may build up (e.g. in the vicinity of fuel, coal, wood, cereal depots, or similar installations) the heater must be switched off to prevent explosions.**

Due to the danger of poisoning and suffocation the heater must not be operated, not even with timer, in enclosed areas such as garages or workshops not equipped with an exhaust venting facility.

When removing the heater the bottom gasket must be renewed.

**The heat exchanger of the air heater remains serviceable for a maximum of 10 years and must then be replaced with an original spare part by the manufacturer or by one of its authorized workshops. The heater must then be provided with a label detailing the sales date of the heat exchanger and the words "original spare part".**

**When replacing the heat exchanger it is mandatory to also replace the overheat protection element (temperature limiter) to avoid possible malfunctions when using the old temperature limiter.**

The heater must be inspected by an expert in time before the beginning of the heating season.

Should the heater develop strong smoke emissions over extended periods of time, unusual combustion operating noise or smell of fuel, the heater must be made inoperative by removing the fuse and returned into service only after inspection by Webasto trained personnel. Claims for warranty may only be made providing evidence by the claimant that maintenance and safety regulations have been met.

Ignoring installation instructions and its procedures will void the warranty by Webasto. The same applies to unskilled repairs or repairs not using original spare parts. This will cause loss of the heater's marks of conformity and thus the vehicle's permit of operation.

## 1.5 Legal Provisions for Installation

For testing the heater in accordance with § 19, 20, or 21 of the StVZO the following regulations are to be observed in particular (§ 22 a StVZO):

Testing is performed upon presentation of the operating and installation instructions of the manufacturer.

The year of the initial operation must be durably marked on the heater identification plate by the installing person.

### Heating Air System

Heating air intake openings must be arranged so that under normal operating conditions exhaust fumes of the vehicle engine or air heater are not likely to be sucked in.

Extracting combustion air from the vehicle interior is prohibited.

### Combustion Air Line

The required air for combustion must be taken in from the exterior.

Within rooms accommodating persons, the combustion air lines must not have more than four disconnects and a splash-water protected exterior wall feedthrough. The disconnects must be sealed in a way not to exceed a leak rate of 200 l/h at an overpressure of 0.5 mbar.

The line including feedthrough, disconnects, material and specific type must be described in the installation instructions.

The line must require tools for installation and removal and must be protected against damage, and must be long-time shockproof.

**Exhaust Line**

The heaters must be designed for exhaust emission to the exterior.

Exhaust lines must be routed so that exhaust fumes are unlikely to penetrate into the vehicle's interior.

The function of any part of the vehicle essential for operation must not be impaired. No condensate or water penetrations may accumulate in the exhaust line. Drain holes may be provided as required; these must drain the liquid to the exterior via drain lines sealed against the vehicle interior.

The exhaust line outlet is to point upwards (with rain protection), or in case of exhaust venting below the vehicle floor, to be located at the nearest possible location of the vehicle's or cockpit side or rear end pointing downwards.

In compartments accommodating persons, exhaust lines must not have more than one disconnect and must have a splash-water protected feedthrough in the exterior wall/floor. For water, that has penetrated into the exhaust line, the connection of a drain line with a metal-sealing joint is permissible. The drain pipe must be routed sealed through the exterior wall or the vehicle floor.

The heat exchanger, the exhaust line connected, as well as the possible drain pipe must be sealed so that with an overpressure double the overpressure of the exhaust having the maximum permissible exhaust line length – at least however at an overpressure of 0.5 bar – a total leak rate of 30 l/h is not exceeded.

The line including feedthrough, disconnects, material and specific type must be described in the installation instructions.

The line must require tools for installation and removal and must be protected against damage, and must be long-time shockproof.

Metal lines must be used. These may not heat to more than 110° C should the possibility of body contact exist within the room interior. Protective devices against body contact may be fitted.

Should exhaust pipes be routed through rooms accommodating persons, these pipes shall be renewed after 10 years using genuine spare parts.

**Combustion Air Inlet and Exhaust Outlet**

In installations these ports for combustion air entry and exhaust fume exit must be of such type, that a ball of 16 mm in diameter cannot be inserted.

Electrical lines, switch gear, and control gear of the heater must be located in the vehicle so that their proper function cannot be impaired under normal operating conditions.

For the routing of fuel lines and the installation of additional fuel tanks §§ 45 and 46 of the StVZO are to be adhered to.

The most important regulations are: fuel lines are to be designed in such a way that they remain unaffected by torsional stresses in the vehicle, engine movement, and the like. They must be protected against mechanical damage.

Fuel-carrying parts are to be protected against heat disturbing operation and are to be arranged so that any dripping or evaporating fuel can neither accumulate nor be ignited by hot components or electrical equipment. In busses fuel lines and fuel tanks may be located neither in the passenger area nor in the driver's compartment. In these type of vehicles the fuel tanks must be located such that they do not pose a direct hazard to the exits in the event of a fire. Fuel supply must not be by means of gravity or pressurization of the fuel tank.

**Installation Instructions for Webasto Fuel Tanks for Fuel Supply of Heaters in Vehicles**

In busses the installation is not permitted in the passengers or driver's compartment.

The fuel filler neck must not be located in the passengers or driver's compartment of any type of vehicle.

The heater operating condition – at least "on" or "off" – must be clearly visible.

**1.6 Corrections and Improvements**

Deficiencies, improvements, or proposals for correction of this workshop manual are to be mailed to:

Webasto Thermosysteme GmbH  
Abt. Technische Dokumentation  
D-82131 Stockdorf  
Telephone: 0 89 / 8 57 94 - 5 42  
Telefax: 0 89 / 8 57 94 - 7 57.

## 2 General Description

The air heaters Air Top 3500 and Air Top 5000 working to the evaporator principle of operation basically consist of the:

- combustion and heating air fan
- heat exchanger
- burner
- combustion tube
- control unit

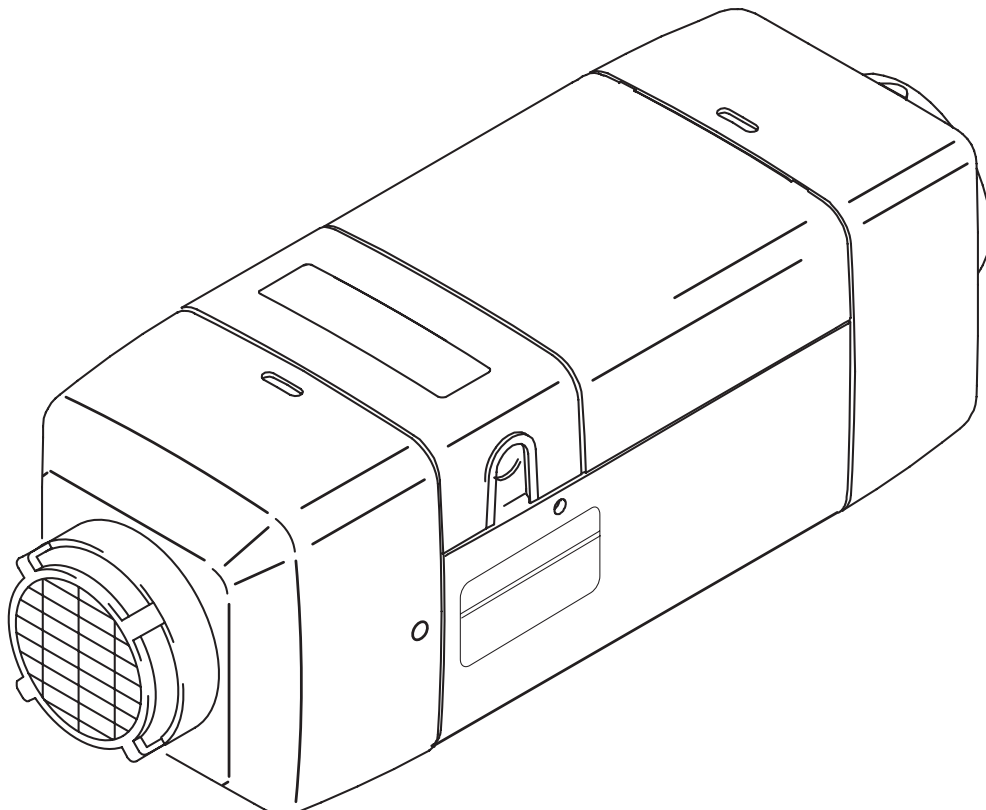
For control and monitoring the following components are located inside the air heater:

- control unit
- glow plug / flame sensor
- analogue temperature limiter
- temperature sensor

The heater may be controlled by means of an external temperature sensor instead of the internal temperature sensor.

Fuel supply is provided by an external dosing pump.

In case of a heater malfunction an error code is output to the display of the combination timer. When equipped with a control element, the operating indicator light will flash. The heater may be additionally checked using a personal computer (refer to operating instructions for PC heater fault diagnosis).

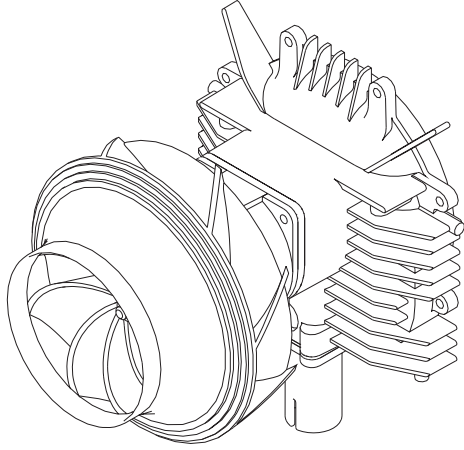


Air Heater Air Top 3500/5000



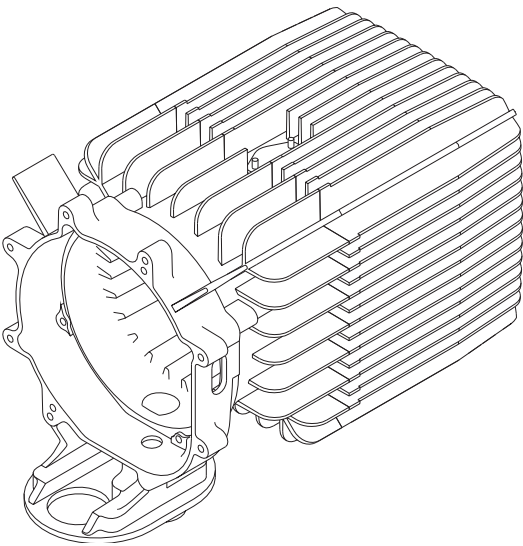
### 2.1 Combustion and Heating Air Fan

The combustion and heating air fan delivers the air necessary for combustion from the combustion air inlet into the burner. The fan also supplies heating air to the heating air outlet.



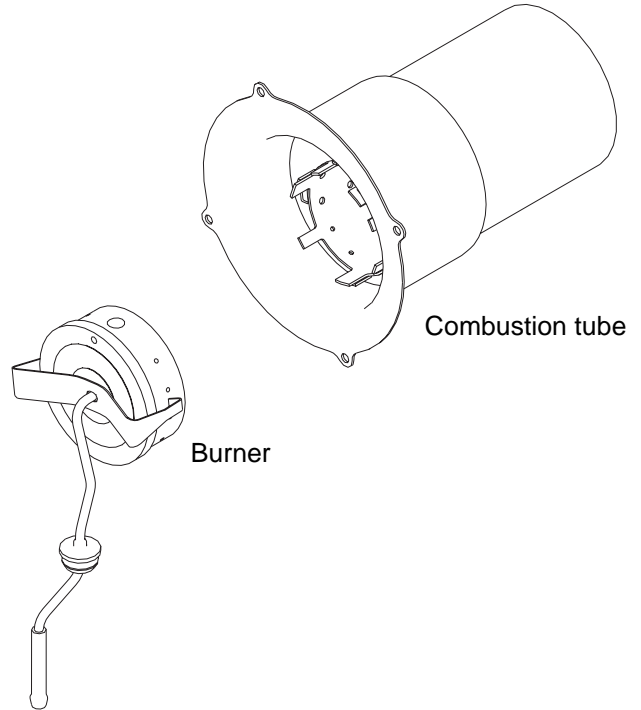
### 2.2 Heat Exchanger

Within the heat exchanger the air delivered by the combustion and heating air fan is charged with the heat generated by combustion.

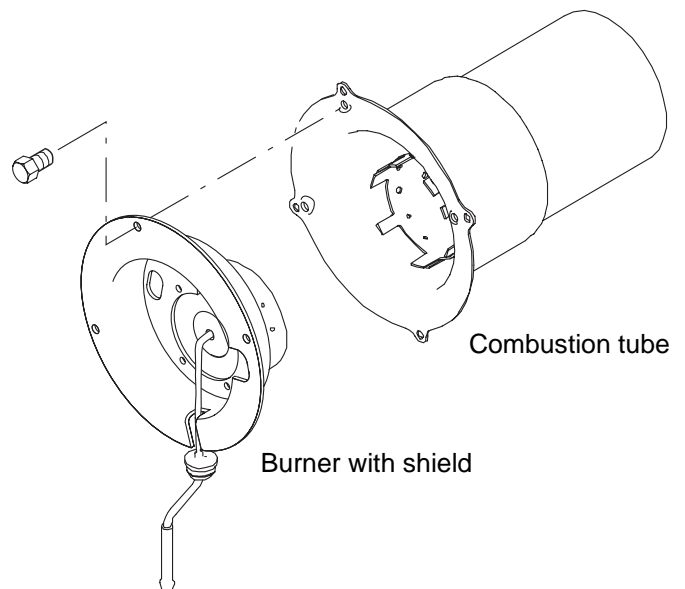


### 2.3 Burner with Combustion Tube

Inside the burner insert fuel is distributed across the combustion tube fuel cross section. Combustion of the fuel/air mixture takes place within the combustion tube to heat the heat exchanger.



or

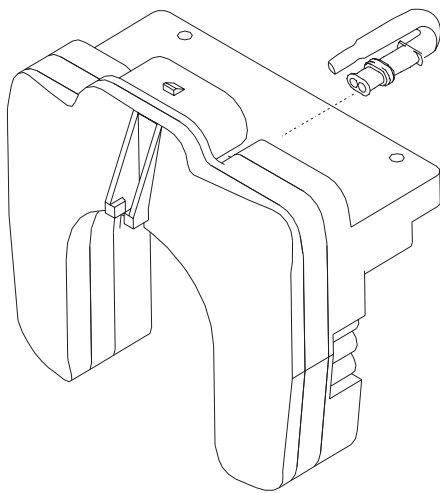


## 2.4 Control Unit

The control unit ensures control and monitoring of combustion operation. A temperature sensor plugged on the control unit is used for temperature control. On all heaters this temperature sensor may be substituted with an externally mounted temperature sensor.

In case of a heater malfunction an error code is output to the display of the combination timer. When equipped with a control element, the operating indicator light will flash.

The heater may be additionally checked using a personal computer (refer to operating instructions for PC heater fault diagnosis).



## 2.5 Glow Plug / Flame Sensor

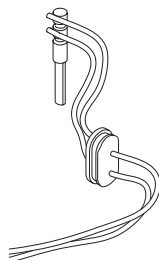
The glow plug also functions as flame sensor.

The glow plug ignites the fuel/air mixture during heater start. The glow plug represents an electrical resistance and is located on the side of the burner exposed to the flame.

When operating as a flame sensor the glow plug behaves like a low Ohm PTC resistor changing its resistance dependent on its heat-up by the flame.

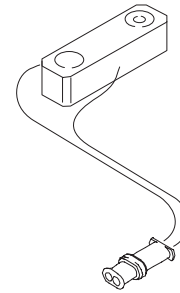
The signals are routed to the control unit for processing.

The flame sensor monitors the flame-up condition throughout the heater time of operation.



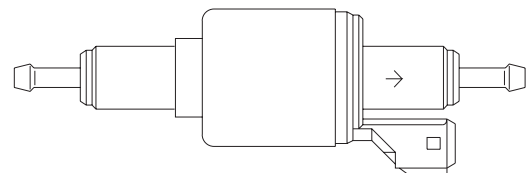
## 2.6 Analogue Temperature Limiter

The analogue temperature sensor protects the heater against undue high operating temperatures. For protection against overheating the temperature limiter responds at a heating air temperature higher than 150° C. The control unit disconnects the dosing pump circuit and deactivates the heater with a run-down. After cooling down the circuit is re-established. The heater may be reactivated by switching the heater off and on again using the control element.



## 2.7 Dosing Pump

The dosing pump is a combined delivery, dosing and shut-off system for the fuel supply of the heater out of the vehicle fuel tank.



### 3 Functional Description (Fig. 301)

#### 3.1 Control Element

The control element is used to switch the heater on and off, to set the desired room temperature (air intake temperature between 5° C and 35° C), to reset the heater after a malfunction with error lockout and to adjust the CO<sub>2</sub> value.

The integrated green LED indication is used as

- operating indicator light (LED permanently on)
- error code/overheat indicator (LED flashes)

#### NOTE

##### Only applicable to ADR operation!

When applying electrical power with the control element still set to "on", e.g. by closing the battery switch, the control unit will go in error lockout. For re-activation the control element must be momentarily switched off and on again.

#### 3.2 Switch on

The control element is to be set to the desired temperature. When switching the heater on the operating indicator light will illuminate. The motor of the combustion and heating air fan runs up at low speed.

#### NOTE

If the temperature of the combustion air taken in exceeds the set temperature, the heater will enter control idle. With the combustion air temperature below the set temperature, the starting sequence commences.

The function of the glow plug/flame sensor is checked. Should the glow plug/flame sensor already signal at this stage "bright" for longer than 60 seconds, there will be a 150 second run-down and an error lockout of the control unit. A malfunction of another component monitored causes an error lockout without run-down.

#### Start

The glow plug/flame sensor is activated. After approximately 22 seconds the dosing pump is put into operation and combustion commences. After 116 seconds the glow plug is deactivated and the flame sensor becomes active. After 136 seconds a check is performed to verify a proper burning of the flame. Detection of a flame will cause the flame to be stabilised for 50 seconds by burning at 1.5 kW. No flame detection will initiate a repeat start.

#### 2nd Start (Repeat Start)

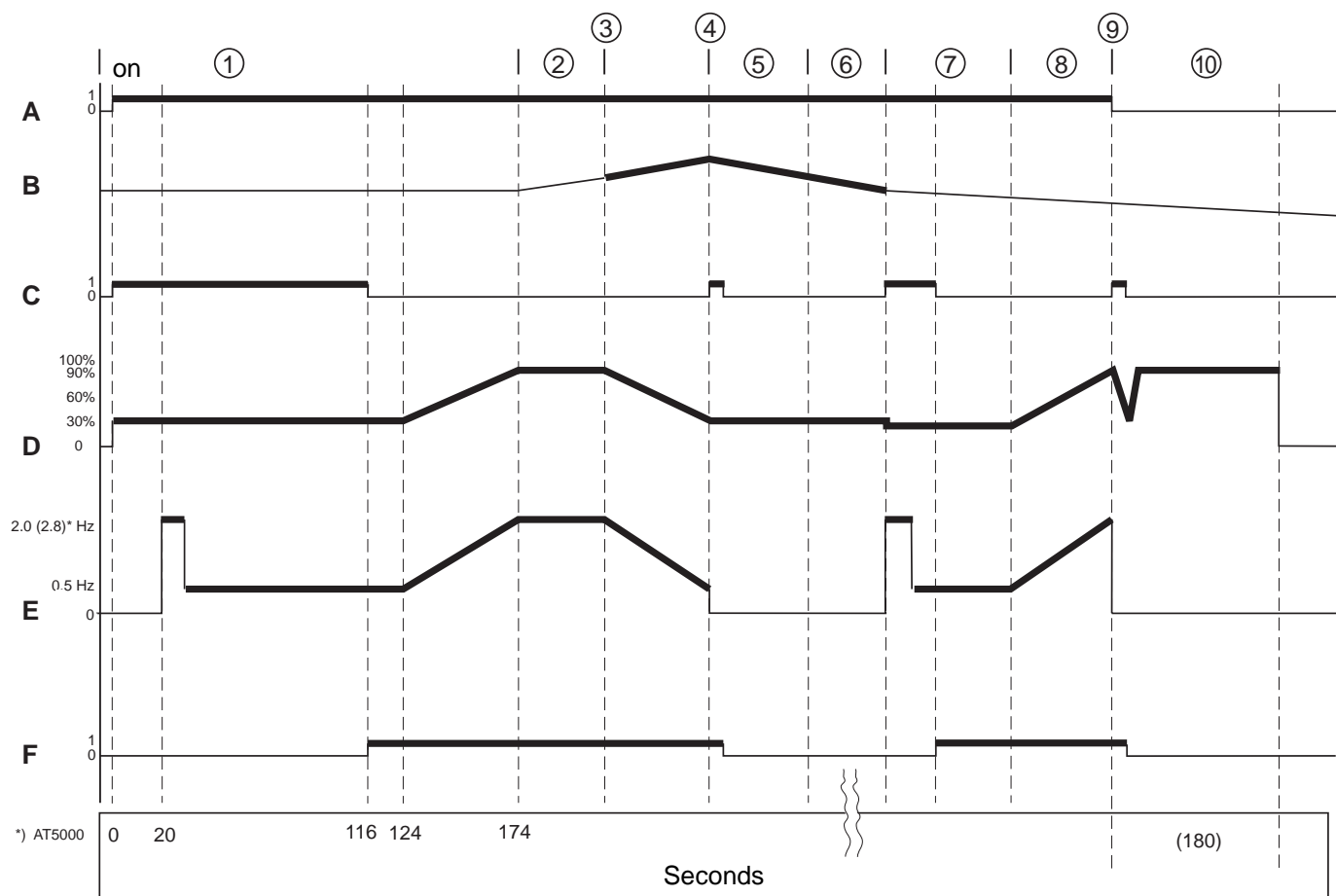
For this purpose the dosing pump is switched off and the glow plug is activated. After 40 seconds the dosing pump is reactivated.

After another 40 seconds the glow plug is deactivated and 20 seconds later the flame is checked. Detection of a flame will cause the flame to be stabilised for approximately 50 seconds by burning at 1.5 kW.

Should flame detection at that time be still negative, there will be a run-down of the combustion and heating air fan at full speed (approx. 5000 rpm) with an error lockout after 180 seconds.

#### NOTE

After the first repeat start the heater enters an error lockout condition. For error lockout reset the heater must be switched off (at least for 2 seconds) and switched on again.



- |  |                                    |
|--|------------------------------------|
| 1 Start  | A = Control element                |
| 2 Controlled operation   | B = Temperature sensor             |
| 3 Rated (set) value achieved   | C = Glow plug                      |
| 4 Rated (set) value exceeded<br>(e.g. due to reduced heat consumption) | D = Combustion and heating air fan |
| 5 Run-down   | E = Dosing pump                    |
| 6 Control idle   | F = Flame sensor                   |
| 7 Start  |                                    |
| 8 Controlled operation (increased heat consumption)                    |                                    |
| 9 Switch off   |                                    |
| 10 Run-down  |                                    |

Fig. 301 Functional Diagram

### 3.3 Heating Operation

During operation there is a flow of combustion gasses through the heat exchanger. The heat of combustion is thereby dissipated onto the heat exchanger walls and is absorbed by the heating air delivered from the heating air fan to be routed to the vehicle passenger cabin.

The temperature of the heating air taken in is measured by a temperature sensor located at the suction side of the heater or with an external temperature sensor. If the measured temperature is below that set with the control element, the performance of the heater will increase up to maximum.

To increase the heater life in continuous operation the dosing pump rate of delivery is reduced for 15 seconds every 10 minutes. After reaching the temperature set with the control element heater performance is reduced by lowering the combustion and heating air fan speed and by decreasing the dosing pump rate of delivery.

### 3.4 Control Idle

#### **NOTE**

The combustion and heating air fan of heaters installed in boats or ships will not operate during control idle.

When exceeding the air intake temperature set with the control element at minimum heating performance, the dosing pump is deactivated and combustion terminates. During run-down lasting 90 seconds and during the total of the control idle period the combustion and heating air fan operates at minimum speed.

If the temperature sensor senses a temperature below the one set with the control element, the heater will restart (without break away torque).

#### **NOTE**

New control element settings will be executed by the control unit/heater with a time delay.

### 3.5 Switch off

Switching the heater off extinguishes the operating indicator light of the control element.

Should fuel delivery have commenced, it will be shut off immediately upon switch off. The heater will be cooled down by a run-down of 180 seconds at full speed.

#### **NOTE**

Reactivation of the heater during run-down is permitted. The run-down will first be completed with a subsequent restart.

### 3.6 Heater Functions when installed in ADR Vehicles

Switch off of the heater with the control element has no influence on the run-down.

A short run-down (max. 20 seconds) will be automatically initiated in case the:

- vehicle engine is stopped
- a conveyor device is activated

The short run-down period depends on the operating condition.

The short run-down period is always 20 seconds.

Run-down speed is the same speed as before switch off.

After an ADR switch off the control unit is in "error lockout" position. Prior to reactivation the control element must be set to "OFF".

### 3.7 Error Lockout

The control unit detects malfunctions of individual heater components and errors in the start sequence and in heater operation. The heater is switched off and enters error lockout under the following conditions:

- **control unit error**
- **no start**
- **flame-out**
- **premature flame detection**
- **temperature sensor open circuit or temperature sensor short circuit**
- **glow plug/flame sensor open circuit or glow plug/flame sensor short circuit**
- **fan motor open circuit or fan motor short circuit or fan motor wrong speed**
- **dosing pump open circuit or dosing pump short circuit**
- **temperature limiter open circuit or temperature sensor short circuit**
- **overheating**
- **voltage too low**, less than **10 Volt** or
- **voltage too high**, more than **15 Volt** for longer than 20 seconds (12 Volt heaters)
- **voltage too low**, less than **20 Volt** or
- **voltage too high**, more than **30 Volt** for longer than 20 seconds (24 Volt heaters)
- **control element open circuit**

Switch off is identical as described in "Switch off". In case of overheating there will be no fuel delivery.

After run-down the control unit will be in error lockout. The control element will display a flash code.

For error lockout reset switch off heater (at least for 2 seconds) and switch on again.

## 4 Technical Data

Where no threshold values are specified technical data in the table are understood to include standard tolerances of  $\pm 10\%$  for heater units at an ambient temperature of  $+20^\circ\text{C}$  and at nominal voltage and nominal conditions.

### Electrical Components:

Control unit, combustion air fan, dosing pump, indicator light in timer\* and glow plug / flame sensor are either for 12 Volt or 24 Volt.

The components timer\*, temperature limiter and temperature sensor are independent of voltage.

\*not for ADR

### Combustible (Diesel / Fuel Oil EL):

The appropriate combustible is the Diesel fuel specified by the vehicle manufacturer. Also class EL fuel oils (not fuel oil L) may be used if their quality is in accordance with the German standard (DIN 51603).

A disadvantageous influence by additives is not known. When using fuel of the vehicle tank the information about additives of the vehicle manufacturer must be observed. When switching to low temperature combustibles the heater must be operated for approximately 15 minutes to also fill the fuel lines and the fuel pump with the new type of fuel.

Heater	Operation	Air Top 3500 D	Air Top 3500 D Volume Plus	Air Top 5000 D
Mark of conformity		~ S306		~ S303
Type		Air heater with evaporator burner		
Heating flow	controlled range	1.5 – 3.5 kW		1.5 – 5.0 (5.5) <sup>1)</sup> kW
Fuel		Diesel		
Fuel consumption	controlled range	0.17 – 0.42 l/h		0.17 – 0.60 (0.66) <sup>1)</sup> l/h
Nominal voltage		12/24 V		12/24 V
Operating voltage range		10.5 – 15/ 21 – 30 V		10.5 – 15/ 21 – 30 V
Nominal power consumption	controlled range	15 – 36 W	15 – 90 W	
Permissible ambient temperature:				
Heater	– operation – storage	–40 – +40° C –40 – +85° C		
Dosing pump	– operation – storage	–40 – +20° C –40 – +85° C		
Control element	– operation – storage	–40 – +75° C –40 – +85° C		
Permissible combustion air intake temperature		–40 – +20° C		
Interior temperature setting range		+10 – +40° C		
Volume flow of heating air against 0.5 bar		max. 139 m <sup>3</sup> /h	max. 218 m <sup>3</sup> /h	
CO <sub>2</sub> in exhaust (perm. functional range)		1.5 kW: 5.0 – 8.0 % 3.5 kW: 9.0 – 12.5 %		1.5 kW: 5.0 – 8.0 % 5.0 kW: 9.0 – 12.5 %
Dimensions of heater		length 425 ± 2 mm width 148 ± 1 mm height 148 ± 1 mm		
Weight of heater		5.9 kg		

<sup>1)</sup> Booster stage, max. 30 min.

**5 Troubleshooting**

**5.1 General**

This section describes the troubleshooting for the heater Air Top 3500 and Air Top 5000.

After heater malfunction an error code is output to the display of the combination or standard timer. When equipped with a control element the operating indicator light will flash. The heater may also be checked with a personal computer (refer to Operating Instructions PC Heater Fault Diagnosis).

**CAUTION**

Troubleshooting requires profound knowledge about components and their theory of operation and may only be performed by trained personnel. In case of doubt functional interrelations may be derived from Sections 2 and 3.

**NOTE**

**For ADR operation only**

When applying electrical power with the control element still set to "on", e.g. by closing the battery switch, as well as after a ADR switch-off, the control unit will go in error lockout. For re-activation the control element must be momentarily switched off and on again or the instant heat switch on the combination timer be operated.

**CAUTION**

Troubleshooting is normally limited to the isolation of defective components. The following possible causes for trouble have not been taken into consideration and must always be excluded as a possible cause or reason for malfunctions:

- **corrosion on connectors**
- **loose contacts on connectors**
- **wrong crimping on connectors**
- **corrosion on wiring and fuses**
- **corrosion on battery terminals**

For checking individual components the electrical connectors on the control unit must be disconnected.

After any fault correction a functional checkout in the vehicle has to be performed.

**5.2 General Failure Symptoms**

The following table (Fig. 501) lists possible failure symptoms of general nature.

Symptom	Probable Cause	Remedy
Heater does not switch off automatically	No combustion after start and restart	Switch off heater momentarily and switch on <u>once again</u>
	Flame-out during operation	Switch off heater momentarily and switch on <u>once again</u>
	Heater overheats Operating indicator light flashes	Check heating air ducting for obstructions, allow heater to cool down, switch off heater momentarily and switch on <u>once again</u>
	Vehicle electrical system power supply underpowered	Charge vehicle battery Switch off heater momentarily and switch on <u>once again</u>
Heater develops black smoke	Combustion air and/or exhaust ducting obstructed	Check combustion air and exhaust ducting for obstructions

Fig. 501 General Failure Symptoms



### 5.3 Failure Symptoms during Operational Sequence

The following table (Fig. 502) lists possible failure symptoms in the time pattern of the functional sequence.

In case of a malfunction this table is to be used for isolation and removal of the malfunction. It is important to clearly identify the failure symptoms.

Should the symptom not be listed in the table or the fault of a symptom listed, cannot be isolated our technicians are available in emergencies (service telephone 0 89 / 8 57 94 - 5 12).

#### NOTE

Overheating and dosing pump failure are always and additionally indicated by a flashing LED of the control element after run-down.

In all cases of malfunction, a faulty control unit could be the cause should the remaining components be serviceable.

Symptom	Symptom shows after ...s	Probable Causes
No start-up and no illumination of LED of control element	immediately	Wrong wiring, defective fuse
No start-up but LED comes on	immediately	Fan or control unit defective or fan blocked
Very low speed without start	immediately	Control idle operation: wrong manual setting (selected temperature on control element below air intake temperature) or wrong heater integration (excessive air intake temperature)
Motor starts to run up but then stops	1	Glow plug/flame sensor open or short circuit or control unit defective
Stop without run-down	5	Fan motor seized or not moving freely
Run-down after	1	Wrong flame detection
Run-down after	20	Control unit electrical supply underpowered
Run-down after and dosing pump does not cycle	120	Wiring to dosing pump, pump itself or temperature limiter defective
Run-down after	40 to 120	Short time interruption of connection to dosing pump or to temperature limiter
Run-down after	230	No flame: wrong fuel quantity, defective fan or fan too slow, coked burner, combustion air/exhaust ducting obstructed or heat exchanger coked, dosing pump seized
Run-down	during combustion operation	Overheating or voltage too low or component failure (glow plug/flame sensor, temperature limiter, dosing pump, burner) or no fuel supply or combustion air/exhaust ducting obstructed
Stop without run-down	during combustion operation	Fan motor failure or seizure
Interruption of dosing pump cycle and max. speed for 30 sec with subsequent restart	during combustion operation	Flame-out by gas bubbles in fuel supply or strong head wind at exhaust outlet or no flame detection erroneous

Fig. 502 Failure Symptoms during Operational Sequence

## 5.4 Error Code Output

When equipped with a combination timer a malfunction will output an error code to the timer display.

### NOTE

When equipped with a control element the error code output after a malfunction will be a flashing operating indicator light/error code indication. The flash pulses correspond to the number of the table below. After a rapid pulse train there will always be an error code output.

### Error code output on display of combination timer

F 00	control unit malfunction / wrong parameter set / warm start detection
F 01	no start (after 2 start attempts) / no flame-up
F 02	flame-out (repeated > 5)
F 03	voltage too low or too high
F 04	premature flame detection
F 06	temperature sensor open circuit or temperature sensor short circuit
F 07	dosing pump open circuit or dosing pump short circuit
F 08	fan motor open circuit or fan motor short circuit or fan motor wrong speed
F 09	glow plug/flame sensor open circuit or glow plug/flame sensor short circuit
F 10	overheating
F 11	temperature limiter open circuit or temperature limiter short circuit
F 12	control element (open circuit/short circuit)

## 6 Functional Checkouts

### 6.1 General

This section describes the tests on the heater in installed and removed condition to prove its serviceability.

#### WARNING

The heater must not be operated in enclosed areas like garages or workshops not provided with exhaust ventilation facilities.

### 6.2 Adjustments

#### 6.2.1 Adjustment of CO<sub>2</sub> Contents

##### 6.2.1.1 General

The CO<sub>2</sub> contents in the exhaust is adjusted by means of the rotary setscrew of the control element. The heater is preset by the manufacturer as applicable for the combustion and heating air fan installed. The manufacturer's setting may be corrected by changing the control element adjustment (CO<sub>2</sub> pin connected to vehicle ground). For adjustment a suitable CO<sub>2</sub> detector must be used.

##### 6.2.1.2 Procedure

1. Connect CO<sub>2</sub> pin (brown cable) in two pin connector of secondary line at wiring harness end of heater to vehicle ground using suitable adapter cable.
2. Switch heater on.
3. Adjust rotary setscrew on control element to centre position.

#### NOTE

Perform CO<sub>2</sub> setting only 2 minutes after flashing of the operating indicator light (stabilization time of CO<sub>2</sub> value).

4. Wait until operating indicator light (LED) flashes.
5. Rotating the setscrew clockwise increases the fan speed and decreases the CO<sub>2</sub> contents. Rotating the setscrew counterclockwise decreases the fan speed and increases the CO<sub>2</sub> contents.

#### NOTE

Set CO<sub>2</sub> contents to 10.5 ± 0.3 % and measure combustion and heating air fan speed afterwards

Air Top 3500: 3900 min<sup>-1</sup> max.

Air Top 5000: 5200 min<sup>-1</sup> max.

When exceeding the max. motor speed with CO<sub>2</sub> value correctly set, check fuel and exhaust lines for restrictions in cross section or cloggings. If o.k. replace combustion and heating air fan according to 9.2.5.

6. After CO<sub>2</sub> contents adjustment allow heater to operate for another five minutes and readjust CO<sub>2</sub> setting as required.
7. Disconnect CO<sub>2</sub> pin from vehicle ground.
8. Wait until flashing operating indicator light (LED) changes to a steady indication.
9. Wait for completion of run-down and switch heater off.

#### NOTE

If setting range is not sufficient (e.g. after replacement of the combustion and heating air fan), repeat setting procedure once.

If the second attempt of CO<sub>2</sub> adjustment is unsatisfactory, a heater component is defective. Return the heater to Webasto Thermosysteme GmbH for testing and repair.

### 6.3 Components Testing

#### CAUTION

For individual components checks the electrical connections on the control unit and the component under test must be disconnected.

#### 6.3.1 Glow Plug / Flame Sensor Resistance Check

When checking the glow plug/flame sensor with a digital multimeter the following values should be obtained:

Glow plug / flame sen.:	12 Volt (red)	24 Volt (green)
Resistance at 25° C:	0.3 ... 0.6 Ω	1.18 ... 1.32 Ω
Test current:	< 5 mA	< 5 mA

## 7 Circuit Diagrams

### 7.1 General

The heater Air Top 3500 and Air Top 5000 may be operated with the control element (rated value setting/switch) or with a combination timer.

The circuit diagrams (Fig. 702 to 706) show possible 12 V or 24 V circuits with:

- control element
- combination timer
- combination timer and battery switch
- control element for ADR
- ADR operation for vehicles without secondary drive

Fig. 701 shows the control unit pin assignment.

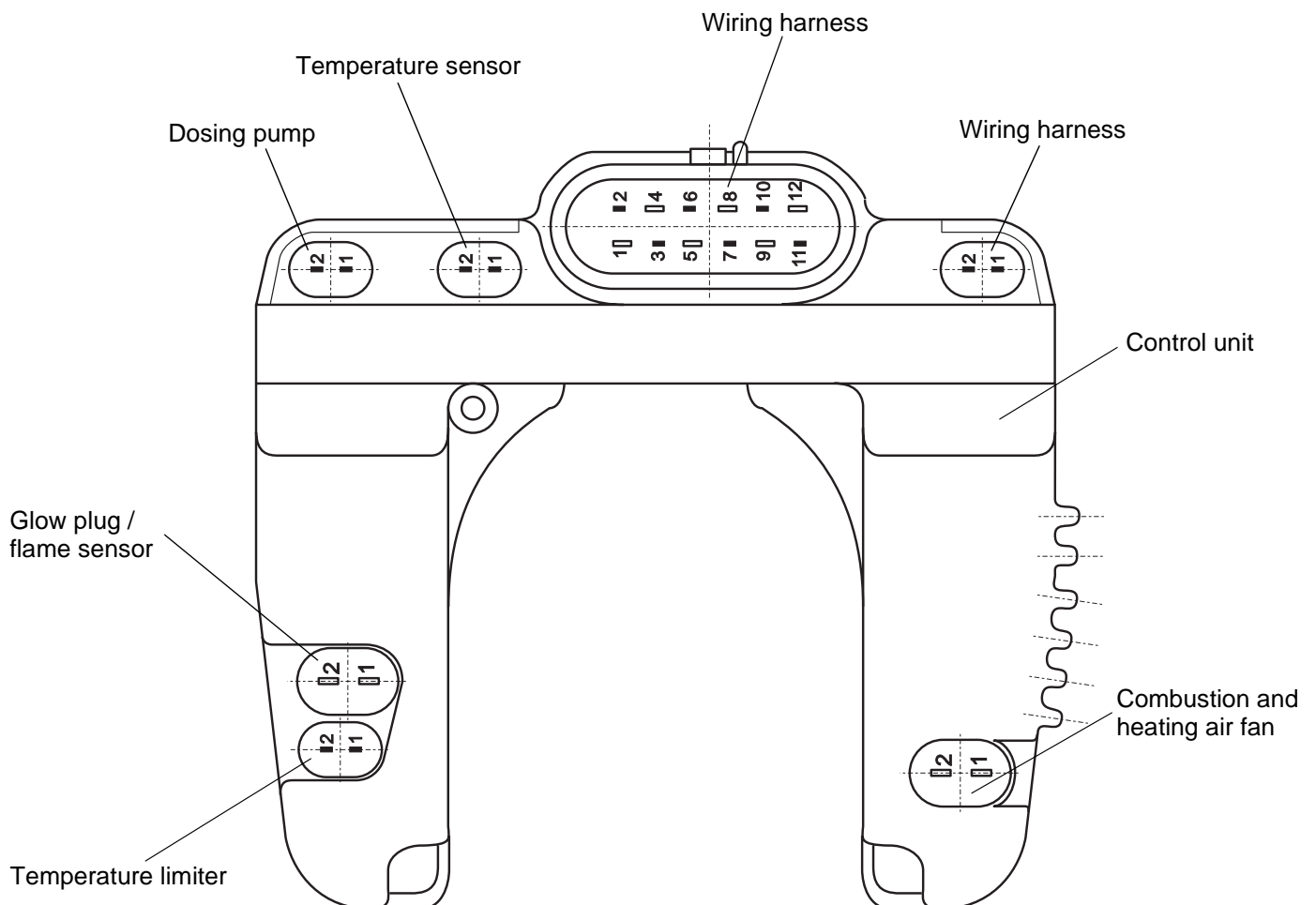
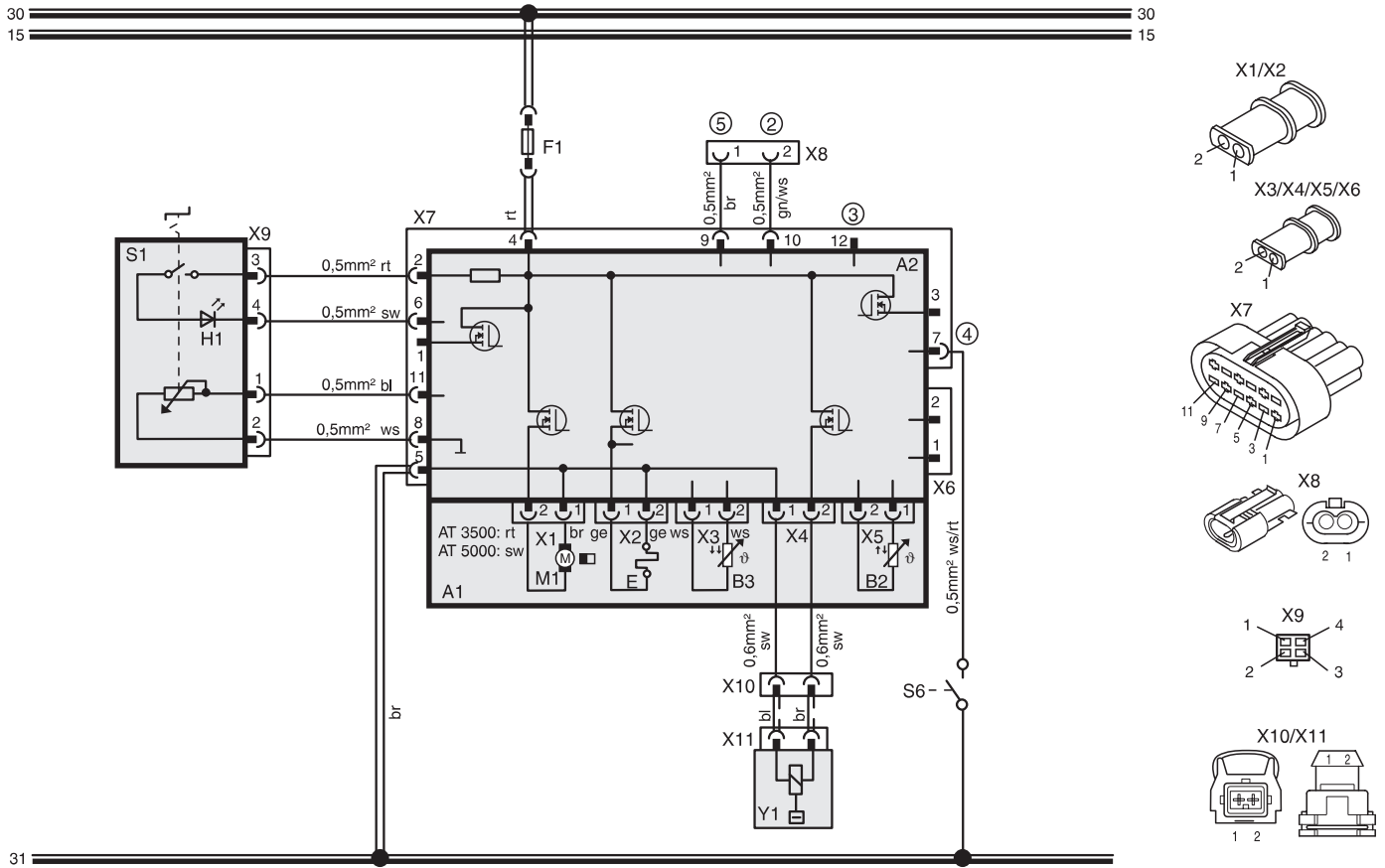


Fig. 701 Control Unit Pin Assignment, Air Top 3500/5000



- ② Diagnosis line K
- ③ Diagnosis line L
- ④ Input pin (pin 7/connector X7), wire colour on wiring harness: ws/rt: "ventilate" (fan speed is dependent on control element position)
- ⑤ CO<sub>2</sub> adjustment

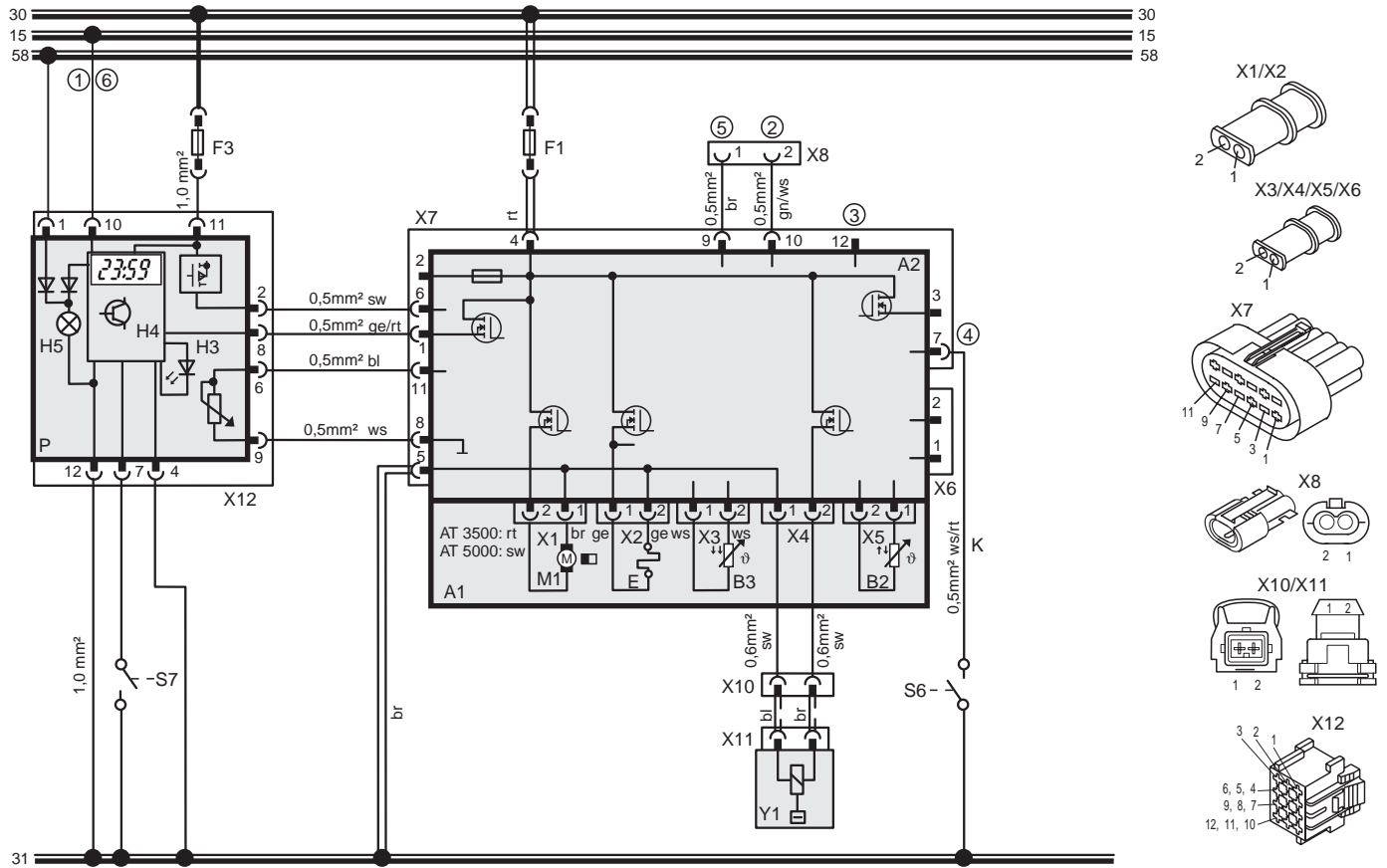
Wire Gauges		
	< 7.5 m	7.5 - 15 m
	4.0 mm <sup>2</sup>	6.0 mm <sup>2</sup>
	2.5 mm <sup>2</sup>	4.0 mm <sup>2</sup>
	1.5 mm <sup>2</sup>	2.5 mm <sup>2</sup>
	1.0 mm <sup>2</sup>	1.5 mm <sup>2</sup>
	0.75 mm <sup>2</sup>	1.5 mm <sup>2</sup>

Wire Colours	
bl	blue
br	brown
ge	yellow
gn	green
gr	grey
or	orange
rt	red
sw	black
vi	violet
ws	white

Item	Nomenclature	Remark
A1	Heater	Air Top 3500/5000
A2	Control unit	
B2	Temperature sensor	
B3	Temperature limiter	Overheat protection
E	Glow plug / flame sensor	
F1	Fuse 24V 15A / 12V 20A	Flat fuse SAE J 1284
H1	LED green (in item S1)	Operating indicator light
M1	Motor	Combustion and heating air fan
S1	Control element	Rated value transmitter-switch
S6	Switch	Ventilate
X1	Connection 2-pole	on item A2 (ST B)
X2	Connection 2-pole	on item A2 (ST V)
X3	Connection 2-pole	on item A2 (ST U)
X4	Connection 2-pole	on item A2 (ST Z)
X5	Connection 2-pole	on item A2 (ST Y)
X6	Connection 2-pole	on item A2 (ST X)

Item	Nomenclature	Remark
X7	Connection 12-pole	on item A2 (ST 1)
X8	Connection 2-pole	
X9	Connection 4-pole	on item S1
X10	Connection 2-pole	
X11	Connection 2-pole	on item Y1
Y1	Dosing pump	

Fig. 702 Automatic Switching Circuit Air Top 3500/5000, 12 V/24 V with Control Element



- ① With plus from terminal (15/75) to connection 10:  
continuous operation in instant heating as long as ignition is on  
Without plus to connection 10:  
heating time programmable as required (10 min to 120 min),  
default setting 120 min
- ② Diagnosis line K
- ③ Diagnosis line L
- ④ Input pin (pin 7/connector X7), wire colour on wiring harness: ws/rt):  
"ventilate" (fan speed is dependent on control element position)
- ⑤ CO<sub>2</sub> adjustment
- ⑥ **NOTE**  
Connection to terminal 30 enables continuous heating operation with ignition off!  
In this case no connection to terminal 15/75 must be made!

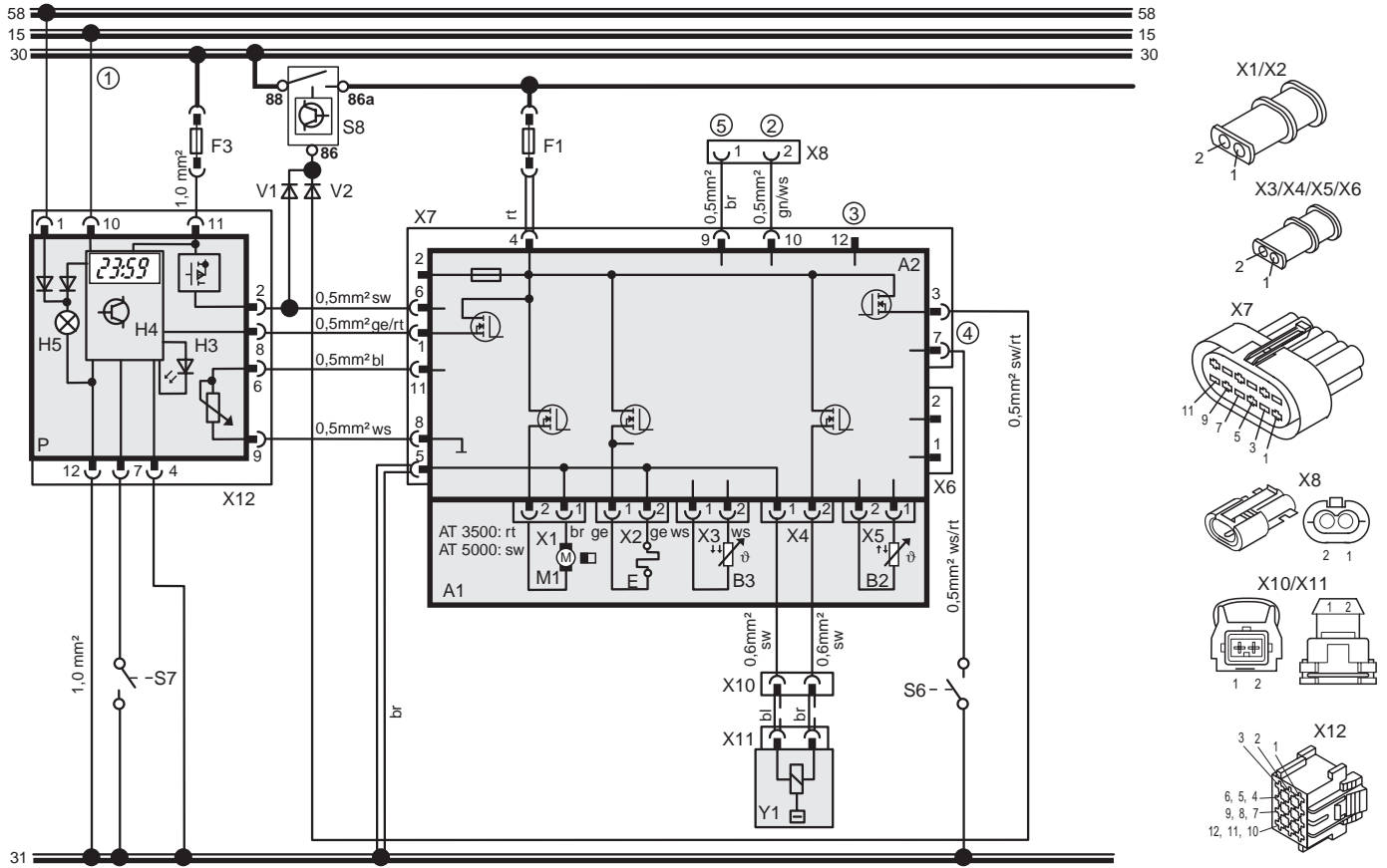
Wire Gauges		
	< 7.5 m	7.5 - 15 m
	0.75 mm <sup>2</sup>	1.5 mm <sup>2</sup>
	1.0 mm <sup>2</sup>	1.5 mm <sup>2</sup>
	1.5 mm <sup>2</sup>	2.5 mm <sup>2</sup>
	2.5 mm <sup>2</sup>	4.0 mm <sup>2</sup>
	4.0 mm <sup>2</sup>	6.0 mm <sup>2</sup>

Wire Colours	
bl	blue
br	brown
ge	yellow
gn	green
gr	grey
or	orange
rt	red
sw	black
vi	violet
ws	white

Item	Nomenclature	Remark
A1	Heater	Air Top 3500/5000
A2	Control unit	
B2	Temperature sensor	
B3	Temperature limiter	Overheat protection
E	Glow plug / flame sensor	
F1	Fuse 24V 15A / 12V 20A	Flat fuse SAE J 1284
F3	Fuse max. 15A	Flat fuse SAE J 1284
H3	LED red (in item P)	Instant heat switch illumination, standby indication, operating indicator light
H4	Heating symbol in display (in item P)	Operating indication
H5	Lights (in item P)	Display and push button switch illumination
M1	Motor	Combustion and heating air fan
P	Combination timer	Timer and rated value transmitter
S6	Switch	Ventilate
S7	Push button switch	Instant heat switch remote control
X1	Connection 2-pole	on item A2 (ST B)

Item	Nomenclature	Remark
X2	Connection 2-pole	on item A2 (ST V)
X3	Connection 2-pole	on item A2 (ST U)
X4	Connection 2-pole	on item A2 (ST Z)
X5	Connection 2-pole	on item A2 (ST Y)
X6	Connection 2-pole	on item A2 (ST X)
X7	Connection 12-pole	on item A2 (ST 1)
X8	Connection 2-pole	
X10	Connection 2-pole	
X11	Connection 2-pole	on item Y1
X12	Connection 12-pole	on item P
Y1	Dosing pump	

Fig. 703 Automatic Switching Circuit Air Top 3500/5000, 12 V/24 V with Combination Timer



- ① With plus from terminal (15/75) to connection 10:  
continuous operation in instant heating as long as ignition is on  
Without plus to connection 10:  
heating time programmable as required (10 min to 120 min),  
default setting 120 min
- ② Diagnosis line K
- ③ Diagnosis line L
- ④ Input pin (pin 7/connector X7), wire colour on wiring harness: ws/rt:  
"ventilate" (fan speed is dependent on control element position)
- ⑤ CO<sub>2</sub> adjustment

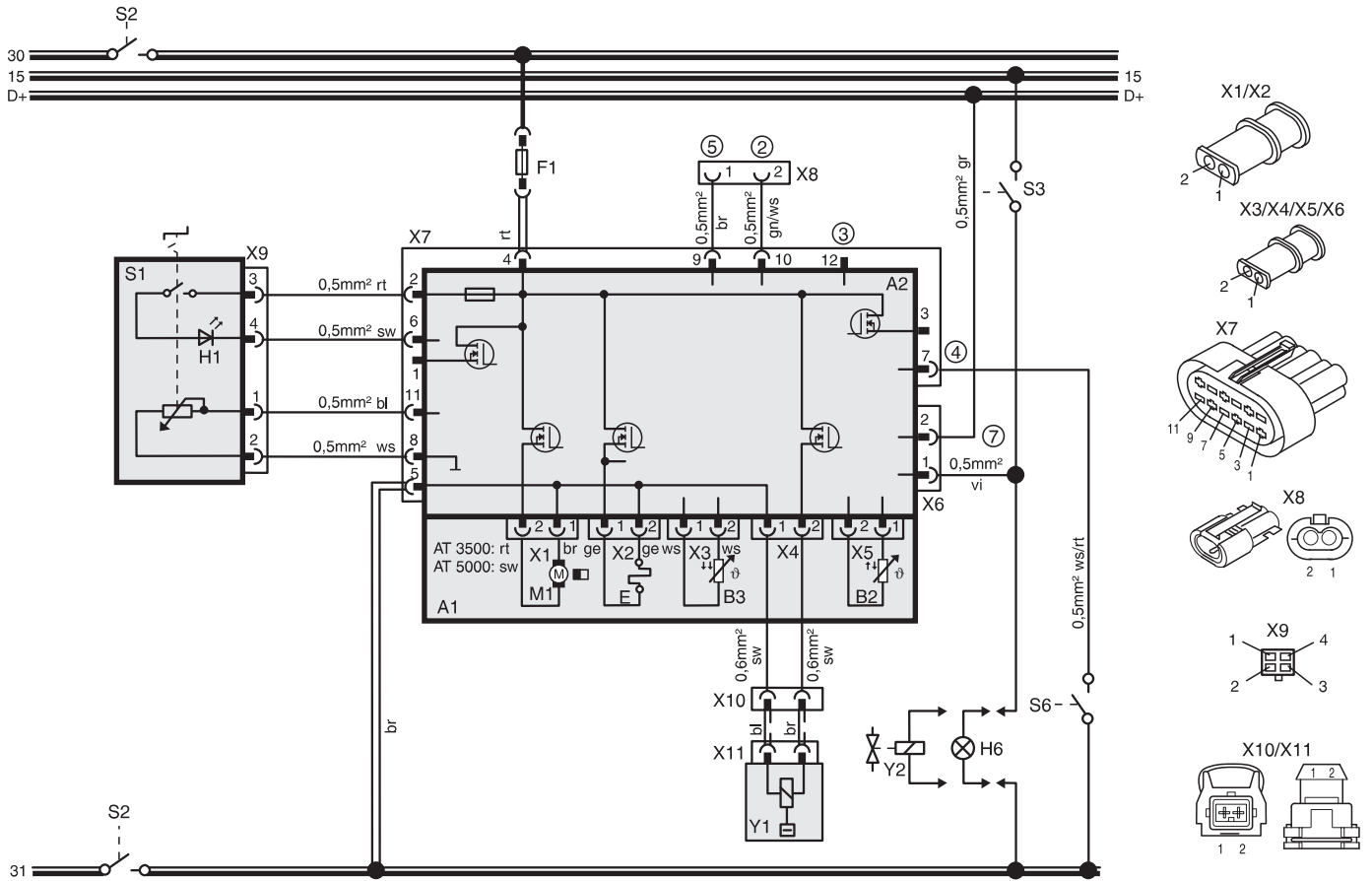
Wire Gauges		
	< 7.5 m	7.5 - 15 m
	0.75 mm <sup>2</sup>	1.5 mm <sup>2</sup>
	1.0 mm <sup>2</sup>	1.5 mm <sup>2</sup>
	1.5 mm <sup>2</sup>	2.5 mm <sup>2</sup>
	2.5 mm <sup>2</sup>	4.0 mm <sup>2</sup>
	4.0 mm <sup>2</sup>	6.0 mm <sup>2</sup>

Wire Colours	
bl	blue
br	brown
ge	yellow
gn	green
gr	grey
or	orange
rt	red
sw	black
vi	violet
ws	white

Item	Nomenclature	Remark
A1	Heater	Air Top 3500/5000
A2	Control unit	
B2	Temperature sensor	
B3	Temperature limiter	Overheat protection
E	Glow plug / flame sensor	
F1	Fuse 24V 15A / 12V 20A	Flat fuse SAE J 1284
F3	Fuse max. 15A	Flat fuse SAE J 1284
H3	LED red (in item P)	Instant heat switch illumination, standby indication, operating indicator light
H4	Heating symbol in display (in item P)	Operating indication
H5	Lights (in item P)	Display and push button switch illumination
M1	Motor	Combustion and heating air fan
P	Combination timer (1631)	Timer and rated value transmitter
S6	Switch	Ventilate
S7	Push button switch	Instant heat switch remote control
S8	Battery switch	

Item	Nomenclature	Remark
V1	Diode	
V2	Diode	
X1	Connection 2-pole	on item A2 (ST B)
X2	Connection 2-pole	on item A2 (ST V)
X3	Connection 2-pole	on item A2 (ST U)
X4	Connection 2-pole	on item A2 (ST Z)
X5	Connection 2-pole	on item A2 (ST Y)
X6	Connection 2-pole	on item A2 (ST X)
X7	Connection 12-pole	on item A2 (ST 1)
X8	Connection 2-pole	
X10	Connection 2-pole	
X11	Connection 2-pole	on item Y1
X12	Connection 12-pole	on item P
Y1	Dosing pump	

Fig. 704 Automatic Switching Circuit Air Top 3500/5000, 12 V/24 V with Combination Timer and Battery Switch



- ② Diagnosis line K
- ③ Diagnosis line L
- ④ Input pin (pin 7/connector X7), wire colour on wiring harness: ws/rt: "ventilate" (fan speed is dependent on control element position)
- ⑤ CO<sub>2</sub> adjustment
- ⑦ **NOTE**  
Grey and violet wires required for ADR function

Wire Gauges		
	< 7.5 m	7.5 - 15 m
—	0.75 mm <sup>2</sup>	1.5 mm <sup>2</sup>
==	1.0 mm <sup>2</sup>	1.5 mm <sup>2</sup>
===	1.5 mm <sup>2</sup>	2.5 mm <sup>2</sup>
====	2.5 mm <sup>2</sup>	4.0 mm <sup>2</sup>
=====	4.0 mm <sup>2</sup>	6.0 mm <sup>2</sup>

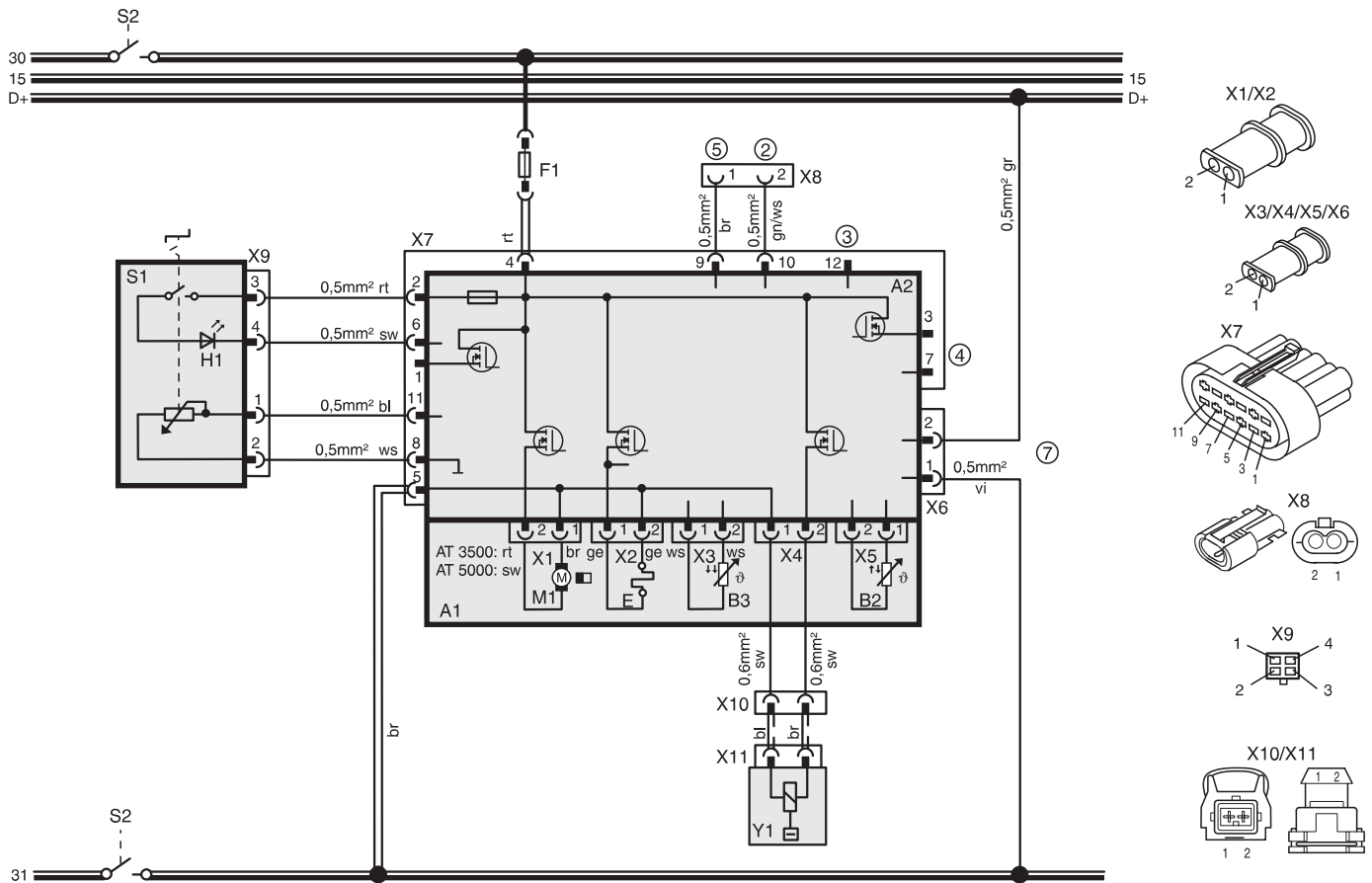
Wire Colours	
bl	blue
br	brown
ge	yellow
gn	green
gr	grey
or	orange
rt	red
sw	black
vi	violet
ws	white

Item	Nomenclature	Remark
A1	Heater	Air Top 3500/5000
A2	Control unit	
B2	Temperature sensor	
B3	Temperature limiter	Overheat protection
E	Glow plug / flame sensor	
F1	Fuse 24V 15A / 12V 20A	Flat fuse SAE J 1284
H1	LED green (in item S1)	Operating indicator light
H6	Light (min. 1.2W)	Operating indicator light conveyor installation
M1	Motor	Combustion and heating air fan
S1	Control element	Rated value transmitter-switch
S2	Disconnect switch 1- or 2-pole	Emergency off switch
S3	Switch	On or for conveyor installation
S6	Switch	Boost or Ventilate
X1	Connection 2-pole	on item A2 (ST B)
X2	Connection 2-pole	on item A2 (ST V)
X3	Connection 2-pole	on item A2 (ST U)

Item	Nomenclature	Remark
X4	Connection 2-pole	on item A2 (ST Z)
X5	Connection 2-pole	on item A2 (ST Y)
X6	Connection 2-pole	on item A2 (ST X)
X7	Connection 12-pole	on item A2 (ST 1)
X8	Connection 2-pole	
X9	Connection 4-pole	on item S1
X10	Connection 2-pole	
X11	Connection 2-pole	on item Y1
Y1	Dosing pump	
Y2	Solenoid valve	

Fig. 705 Automatic Switching Circuit Air Top 3500/5000, 24 V ADR Operation with Control Element





- ② Diagnosis line K
- ③ Diagnosis line L
- ④ Input pin (pin 7/connector X7), wire colour on wiring harness: ws/rt):  
"ventilate" (fan speed is dependent on control element position)
- ⑤ CO<sub>2</sub> adjustment
- ⑦ **NOTE**  
Grey and violet wires required for ADR function

Wire Gauges		
	< 7.5 m	7.5 - 15 m
	0.75 mm <sup>2</sup>	1.5 mm <sup>2</sup>
	1.0 mm <sup>2</sup>	1.5 mm <sup>2</sup>
	1.5 mm <sup>2</sup>	2.5 mm <sup>2</sup>
	2.5 mm <sup>2</sup>	4.0 mm <sup>2</sup>
	4.0 mm <sup>2</sup>	6.0 mm <sup>2</sup>

Wire Colours	
bl	blue
br	brown
ge	yellow
gn	green
gr	grey
or	orange
rt	red
sw	black
vi	violet
ws	white

Item	Nomenclature	Remark
A1	Heater	Air Top 3500/5000
A2	Control unit	
B2	Temperature sensor	
B3	Temperature limiter	Overheat protection
E	Glow plug / flame sensor	
F1	Fuse 24V 15A / 12V 20A	Flat fuse SAE J 1284
H1	LED green (in item P1)	Operating indicator light
M1	Motor	Combustion and heating air fan
S1	Control element	Rated value transmitter-switch
S2	Disconnect switch 1- or 2-pole	Emergency off switch
X1	Connection 2-pole	on item A2 (ST B)
X2	Connection 2-pole	on item A2 (ST V)
X3	Connection 2-pole	on item A2 (ST U)
X4	Connection 2-pole	on item A2 (ST Z)
X5	Connection 2-pole	on item A2 (ST Y)
X6	Connection 2-pole	on item A2 (ST X)

Item	Nomenclature	Remark
X7	Connection 12-pole	on item A2 (ST 1)
X8	Connection 2-pole	
X9	Connection 4-pole	on item S1
X10	Connection 2-pole	
X11	Connection 2-pole	on item Y1
Y1	Dosing pump	

Fig. 706 Automatic Switching Circuit Air Top 3500/5000, 24 V ADR Operation with Control Element and no Auxiliary Drive

## 8 Servicing

### 8.1 General

This section describes the servicing procedures allowed on the heater when installed.

### 8.2 Work on the Heater

For any type of work on the heater the fuses for the heater must be removed. As long as the heater is in operation or in run-down the battery main power supply must not be disconnected to prevent the heater from overheating by response of the overheat protection.

Repairs requiring a change of location the relevant installation instructions and the vehicle specific heater installation proposal have to be observed.

### 8.3 Work on the Vehicle

#### CAUTION

In the vicinity of the heater a temperature of 85° C must under no circumstances be exceeded (e.g. during paint work on the vehicle).

### 8.4 Heater Test Run

#### WARNING

The heater must not be operated in enclosed areas like garages or workshops not provided with exhaust ventilation facilities.

#### CAUTION

Operation of the heater without control unit cover is not permitted and causes overheating.

### 8.5 Servicing

#### NOTE

To prevent seizure of mechanical components the heater should be operated every 4 weeks for at least 10 minutes.

The heater does not require any maintenance. It should however be inspected in regular intervals by Webasto trained maintenance personnel, the latest date for inspection being the start of the heating season (point of time with increased use of heater).

To ensure functional reliability of the heater the following servicing must be performed:

- inspect heating air inlet and outlet for contamination and foreign matter. (Contaminations or obstructions in heating air lines may cause overheating and thus response of the temperature limiter.)
- clean heater exterior (prevent the ingress of water).
- examine electrical connections for corrosion of contacts and for security.
- inspect combustion air and exhaust ducting for damage and obstructions.
- inspect fuel lines and fuel filter for leakage.
- replace fuel filter, if installed.

## 8.6 Visual Inspections and Installation Regulations

### 8.6.1 Heating Air System

#### CAUTION

Integration of the heater in the vehicles own air ducting is not allowed due to the high pressure in the vehicle system.

Both the circulation and ventilation mode of operation are permitted. In fresh air ventilation mode ensure to use heating air only from areas protected against splash and spray water.

On the air intake side of the heater a temperature sensor is located, which in combination with the control element, makes the heater operate with adequate heating performance dependent on air intake temperature and control element setting. Heating performance is set so that after fast heat-up to the preselected indoor temperature this temperature will be maintained.

#### NOTE

In the fresh air ventilation mode of operation or when installing the heater in an installation box, an external temperature sensor must be mounted in the room area to be under heat control!

The temperature sensor must not be mounted on exterior walls without insulation. It must also be protected against direct exposure to sun and draught wind.

Minimum inner diameter of heating air duct:

80 mm	Air Top 3500
90 mm	Air Top 5000

#### NOTE

For heating air ducting only materials with a temperature resistance of at least 150° C may be used. The heating air opening is to be located so that components not temperature resistant are exposed to the heating air flow.

Maximum pressure drop between suction and pressure side of heating air duct:

- 2.0 mbar (20 mm water column) Air Top 3500
- 3.0 mbar (30 mm water column) Air Top 5000

**NOTE**

Exceeding this value will cause the temperature limiter to respond. The heating air hose connections must be secured.

In the air circulation mode the heater may be used without any accessories for heating air ducting. A short circuit of the heating air flow should be avoided.

### 8.6.2 Fuel Supply

Fuel supply is from the vehicle fuel tank or a separate fuel reservoir. Fig. 801 lists the pressure permitted at the fuel tapping location.

Permitted fuel feed height (H) m	at max. permissible overpressure (bar) in fuel line
0.00	0.20
1.00	0.11
2.00	0.03
Permitted suction height S (m)	at max. permissible negative pressure (bar) in fuel tank
0.00	-0.10
0.50	-0.06
1.00	-0.02

### 8.6.2.1 Fuel Tapping

Diesel fuel tapping must be from the fuel tank or a separate fuel reservoir (Fig. 802, 803 and 804). This separate fuel tapping avoids an influence on the pressure.

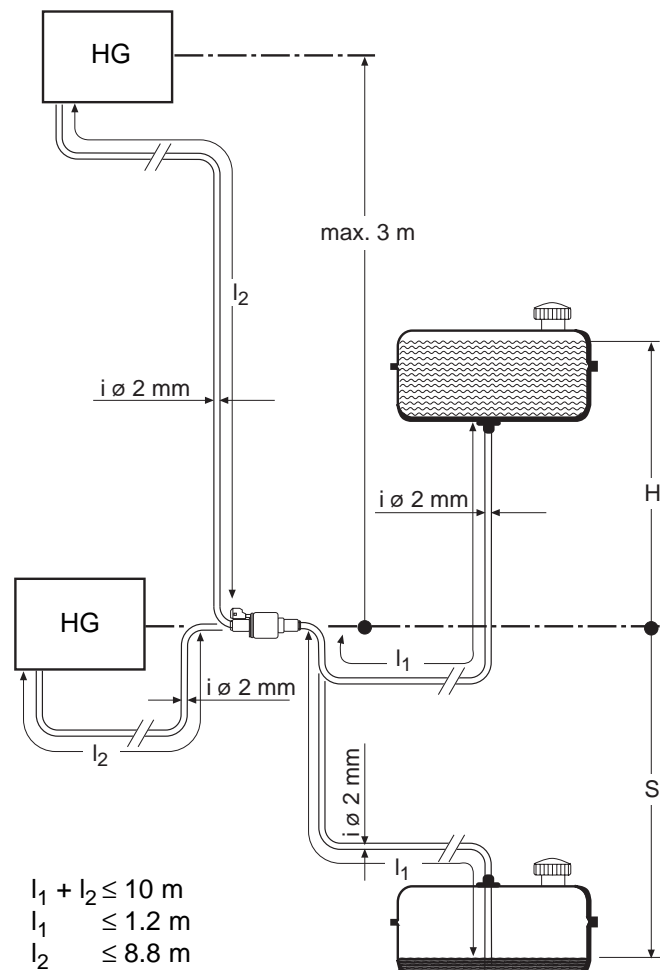


Fig. 801 Fuel Supply

Hole Pattern

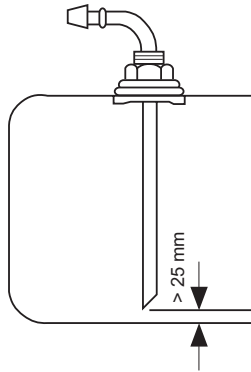
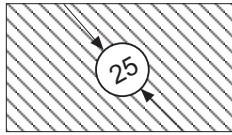


Fig. 802 Webasto Fuel Tap\*

\*Fuel tap to be used only for metal fuel tanks

Fuel Tank Tap

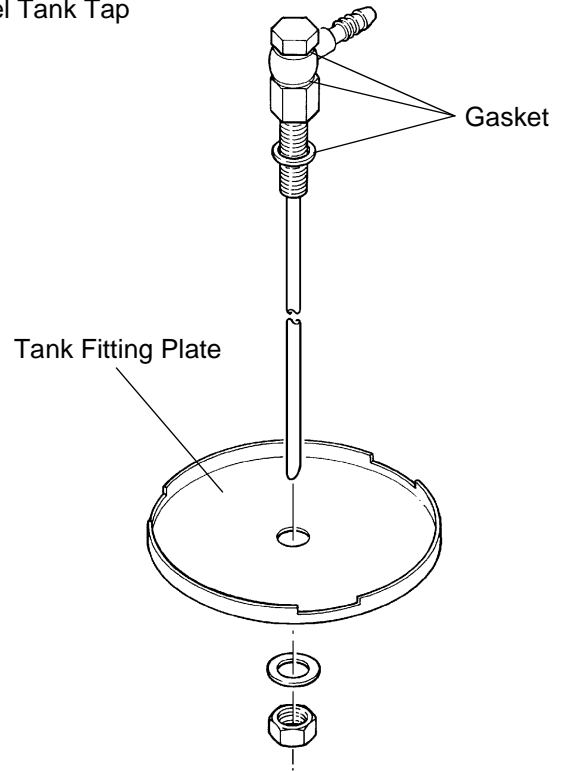


Fig. 804 Fuel Tapping from Plastic Tank (tapping via fitting plate)

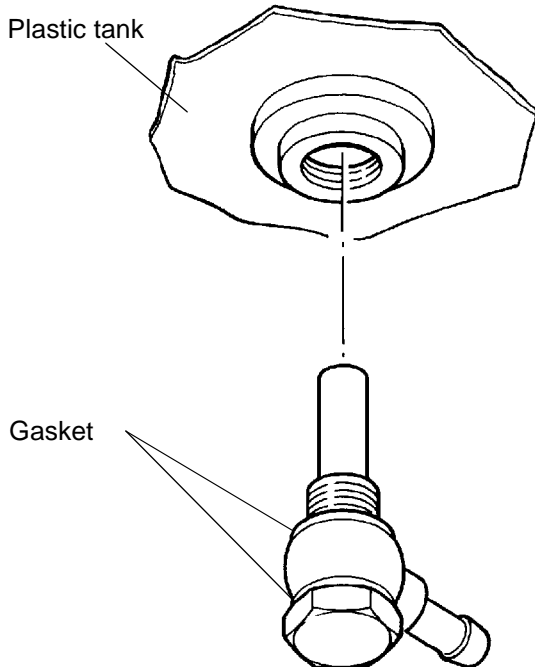


Fig. 803 Fuel Tapping from Plastic Tank (tapping via fuel drain plug)

**NOTE**

Tank fitting plate to be made from sheet metal!

**8.6.2.2 Fuel Lines**

Fuel lines may only be steel, copper, or plastic lines made of unhardened, light and temperature stabilised PA 11 or PA 12 (e.g. Mecanyl RWTL) according to DIN 73378. A descending line routing from the dosing pump to the heater should be avoided.

As a permanently rising fuel line routing cannot always be ensured, the inner diameter must not exceed a certain value. Too large inner diameters cause air or gas bubbles to accumulate resulting in malfunctions should the lines be descending or having sags. The diameters specified in Fig. 801 ensure no disturbing formation of bubbles.

Loose fuel lines must be secured in order to avoid sagging. The installation must ensure protection against stone impacts and **undue temperatures** (exhaust line). Fuel line connections must be secured against slippage using hose clamps.

**Connection of 2 Pipes with Hose**

The correct connection of fuel lines with hoses is shown in Fig. 805.

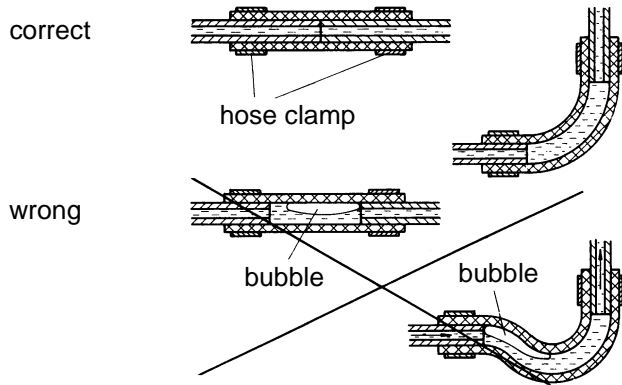
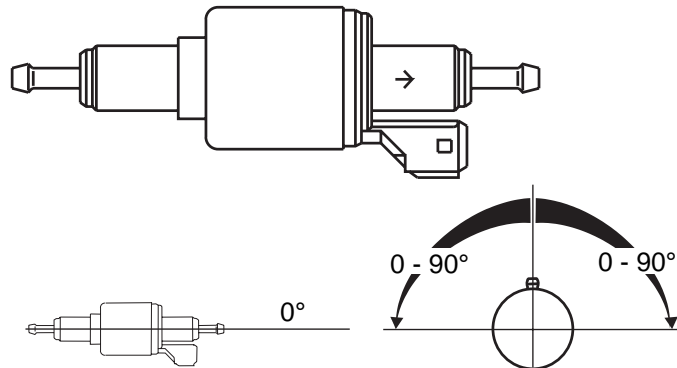


Fig. 805 Pipe/Hose Connection

**8.6.3 Dosing Pump**

The dosing pump is a combined delivery, dosing and shut-off system and is subject to certain installation criteria (Fig. 801 and 806).



12 Volt and 24 Volt  
**Installation position horizontal only**

Fig. 806 Dosing Pump, Installation Position

**8.6.3.1 Installation Position**

It is advantageous to mount the dosing pump in a cool location. The ambient temperature must never exceed +20° C during operation.

Dosing pump and fuel lines must not be installed in locations exposed to heat radiated by hot vehicle components (e.g. exhaust line). A heat shield is to be provided as necessary.

**8.6.3.2 Installation and Attachment**

The dosing pump is to be attached with an anti-vibration mount. The installation location is limited according to Fig. 806 to ensure sufficient self-venting capability. Due to the danger of corrosion only Webasto original parts may be used for the plug connection between dosing pump and dosing pump wiring harness.

**8.6.4 Fuel Filter**

If fuel contaminations are expected, only Webasto filter order no. 487 171 may be used. The filter installation should be vertical and never exceed horizontal (observe direction of flow).

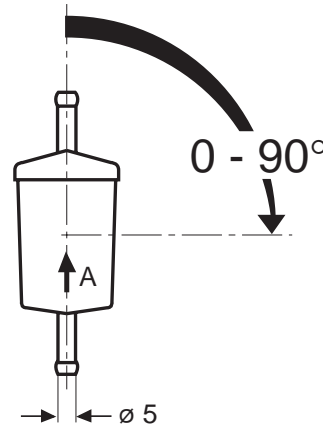


Fig. 807 Fuel Filter

**8.6.5 Combustion Air Supply**

The combustion air must not be taken in from rooms accommodating persons. The intake must not point in the direction of forward motion. The combustion air intake must be located so that clogging by contamination is not to be expected.

The use of an air intake muffler or an equivalent air intake extension is necessary.

If the heater is contained in an installation box, the combustion air must be taken in from and the exhaust vented to the exterior. The line feedthroughs must not allow exhaust fumes to enter the vehicle interior.

In order to avoid damage to the dosing pump cable, no exhaust line must be used for extension of the combustion air supply line.

**8.6.6 Exhaust Line**

Rigid pipes of unalloyed steel with a minimum wall thickness of 1.0 mm or flexible hoses of alloyed steel only may be used as exhaust ducts. The exhaust line is fastened to the heater e.g. with a hose clamp.

The exhaust muffler is to be preferably mounted near the heater, the direction of flow is optional. Operation of the heater is also permitted without exhaust muffler.

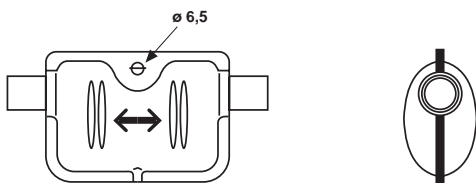


Fig. 808 Exhaust Muffler, Direction of Flow

**8.6.7 Combustion Air Intake and Exhaust Lines**

Max. total length of the combustion air intake and exhaust line:

with muffler:	max. 2.6 m
without muffler:	max. 5.6 m

Both lines are to be routed away from the heater in a descent. If this is not possible, a condensate drain hole with a diameter of 4 mm must be provided at the lowest point.

Inner diameter of the lines:	
combustion air intake line:	25 mm
exhaust line (metal):	24 mm

**NOTE**

Exhaust line lengths exceeding 2 m require the use of insulated exhaust lines (dew point below minimum).

Smallest bending radius:	50 mm
--------------------------	-------

Sum of bends:	
combustion air intake line:	max. 270°
exhaust line:	max. 270°

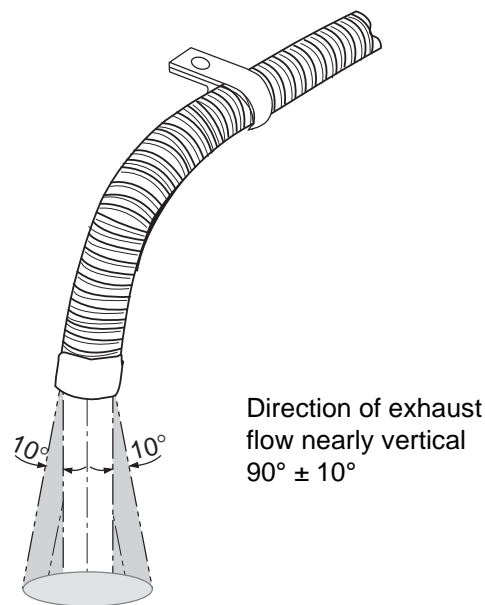


Fig. 809 Installation Arrangement of Exhaust Pipe Outlet

In order to ensure an angle of  $90^\circ \pm 10^\circ$ , an attachment is required away not more than 150 mm from the exhaust pipe end.

**WARNING**

Any other installation of the exhaust pipe outlet as shown in Fig. 809 will provoke the danger of fires.

8.6.8 Electrical Connections

8.6.8.1 Connection of Heater, Control Element

The electrical connection is according to the circuit diagram (see Section 7). For connection to the wiring harness the cover on the heater must be removed and the wiring harness connector be plugged onto the heater.

Prior to first operation of the heater the cover must be fitted to avoid undue escape of heating air (heater overheating). The cable passage may be on the left or right.

8.6.8.2 Connection of Power Supply

Preferably from the vehicle central electrics.

For heater protection an additional flat fuse holder (included in the heater delivery) must be fitted. The fuse holder may only be installed in the vehicle interior.

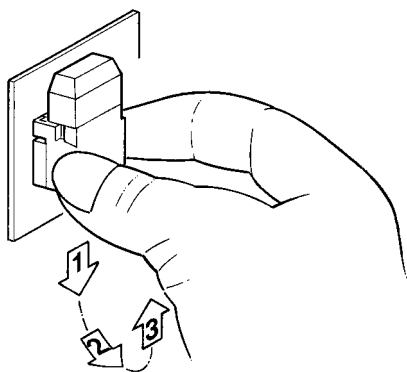


Fig. 810 Removal of the Fuse Holder Mounting Plate

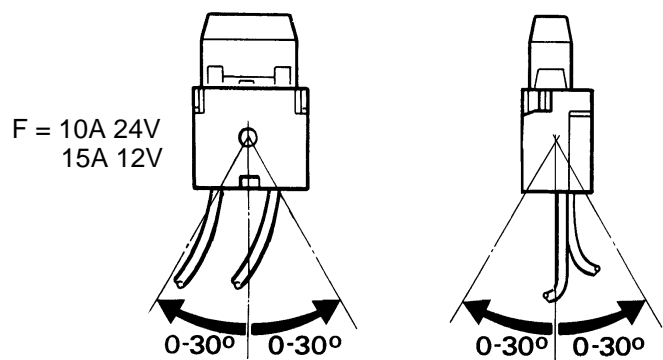


Fig. 811 Fuse Holder Installation Position

8.6.8.3 Connection of Control Element

The wiring harness is prepared for connection to the control element (rated value transmitter). For disconnection of the connector simply pull on the connector terminal (Fig. 813). Pulling on the wiring harness will lock the connector (self-locking).

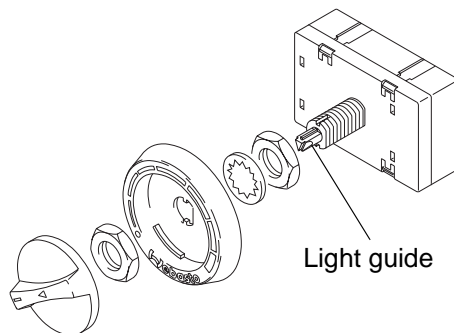


Fig. 812 Control Element

NOTE

Light guide must contact rotary knob.

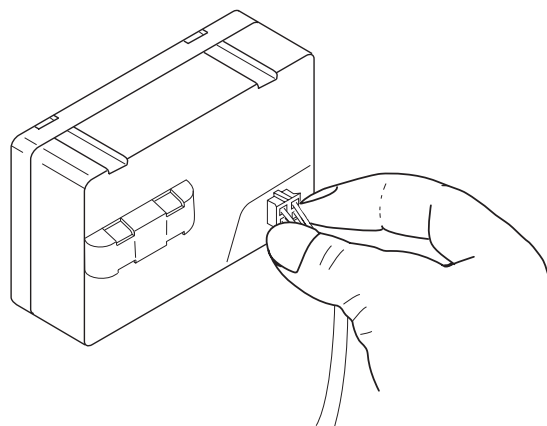
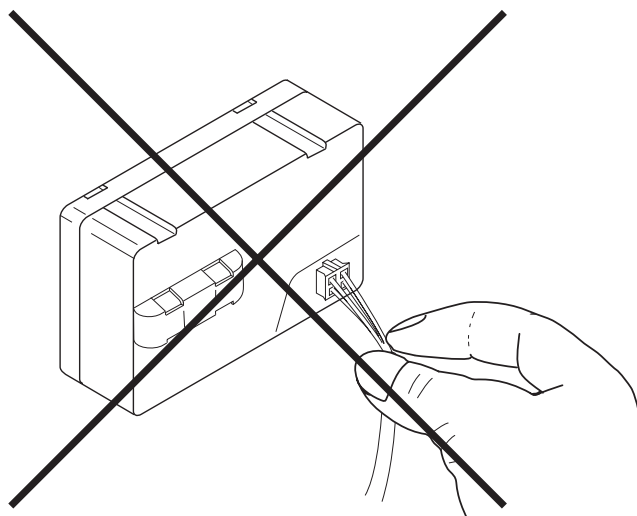
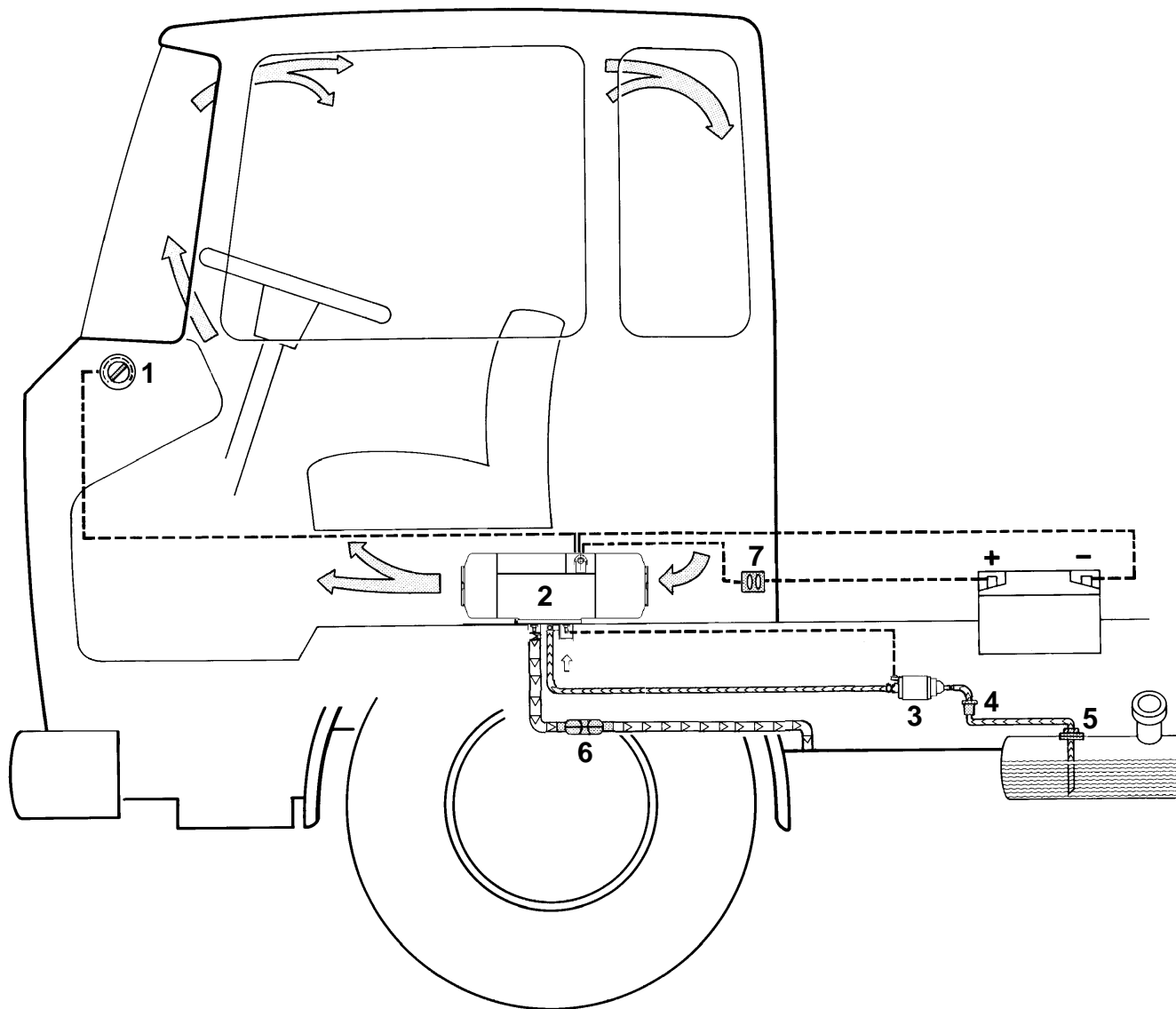


Fig. 813 Pulling the Connector



- 1 Control element
- 2 Heater
- 3 Dosing pump
- 4 Fuel filter (accessory)
- 5 Fuel tap
- 6 Exhaust muffler (accessory)
- 7 Flat fuse holder

Fig. 814 Sample Installation of Air Heater for Air Circulation Mode of Operation



**8.7 Removal and Installation****CAUTION**

With the heater installed no component removal or disassembly procedures are permitted.

**8.7.1 Heater, Removal and Installation****8.7.1.1 Removal**

1. Disconnect vehicle battery.
2. Remove cover from upper housing shell according to 9.2.1.1.
3. Disconnect wiring harness connector from heater.
4. Disconnect fuel supply line from heater.
5. Disconnect combustion air intake line and exhaust line from heater.
6. Remove four nuts and washers from heater.
7. Remove heater and discard gasket.

**8.7.1.2 Installation**

1. Locate heater with new gasket for installation and secure with four nuts and washers (use Webasto original nuts only).
2. Tighten nuts with 6 + 1 Nm.
3. Connect and secure fuel supply line to heater.
4. Connect and secure combustion air intake line and exhaust line to heater.
5. Route cable to dosing pump and connect to dosing pump.
6. Connect wiring harness connector to control unit.
7. Plug on cover and arrest.
8. Reconnect vehicle battery.
9. Bleed fuel supply system.

**8.8 Initial Operation**

After heater installation the fuel supply system must be carefully bled.

**NOTE**

Due to the low fuel consumption it is required to switch the heater several times on and off for priming the fuel line.

During the heater test run inspect all connections for leakage and security. Should the heater during operation enter an error lockout condition, perform troubleshooting.

## 9 Repair

### 9.1 General

This section describes the repairs that may be performed on the heaters Air Top 3500 and Air Top 5000 when removed.

Any further disassembly will void the warranty. For assembly only spares from the original spares kits must be used.

#### 9.1.1 Work on Components after Disassembly

##### CAUTION

All gaskets located between disassembled components as well as the gasket on the exhaust outlet must always be discarded and replaced.

##### 9.1.1.1 Cleaning

- All components disassembled must be cleaned with cleaning spirit and blown dry with pressurised air.
- Sealing compound on components must be carefully and completely removed using suitable means.

##### 9.1.1.2 Visual Inspection

- Inspect all components for damages (cracks, deformation, wear, etc.) and replace as required.
- Inspect connectors and wiring for corrosion, loose contacts, wrong crimping, etc. and repair as required.

#### 9.1.2 Modification Procedures

##### NOTE

A continuous design improvement of the heaters is intended for their optimization to prevent failures or malfunctions.

Normally equipment already in operation may be modified by retrofits using the relevant modification kits available.

The following details modifications, which may be easily performed at low expenditure during repairs:

- installation of an external temperature sensor for best temperature control (see 9.1.2.1).
- installation of a burner with shield (see 9.1.2.2).

#### 9.1.2.1 Installation of an External Temperature Sensor

##### General

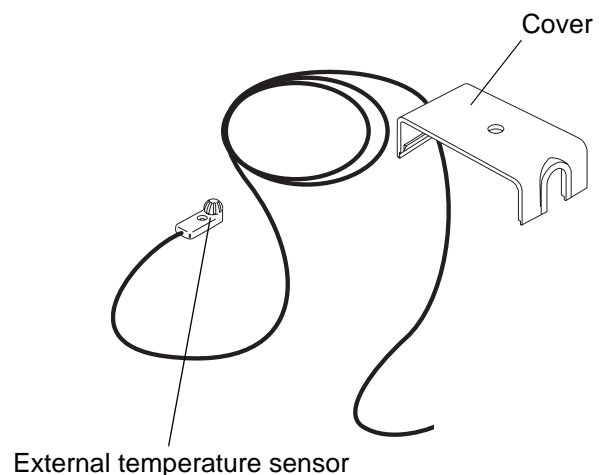
The heater Air Top 3500 and Air Top 5000 control the desired temperature the best when the air temperature of the most frequented area is applied to its temperature sensor. This may sometimes not be possible for the temperature sensor integrated in the heater due to unfavourable installation conditions. In such case optimum temperature control may be achieved by installing an external temperature sensor in the appropriate room area.

##### Procedure

1. Select appropriate installation location for the external temperature sensor.

##### NOTE

- The temperature sensor should not be directly exposed to warm air flow and not be located in the vicinity of heat sources (e.g. vehicle's own heating system).
  - It should be mounted in mid height of the vehicle cabin on possibly vertical surfaces.
  - The installation location should not be exposed to direct sunlight.
  - Do not mount temperature sensor behind curtains or similar.
2. Remove cover (see 9.2.1.1) and pull off internal temperature sensor.
  3. Mount external temperature sensor and route cable to heater.
  4. Connect electrical connector and fit cover.
  5. Perform heater test run and check control behaviour.



## 9.1.2.2 Installation of Burner with Shield

### General

Retrofit kit, 12 V (Ident. No. 679 84A)

Retrofit kit, 24 V (Ident. No. 679 56A)

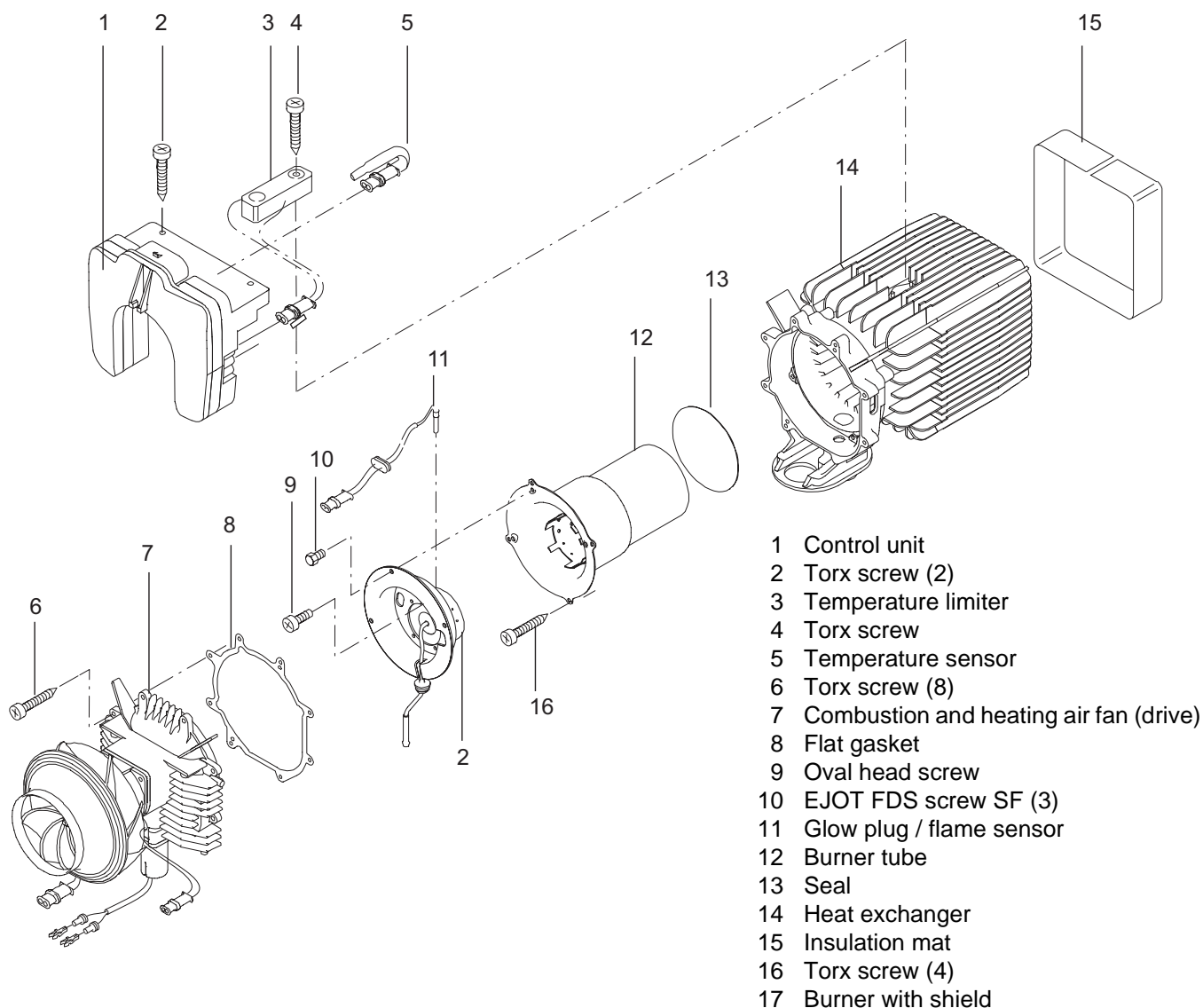
The retrofit kit includes:

- 1 Burner with shield
- 1 Combustion tube
- 3 EJOT FDS screws SF

### Procedure

1. Remove burner with burner tube and discard (see 9.2.8.1).
2. Insert glow plug / flame sensor (11) in burner with shield (17) (cable routed towards opening for cable grommet in shield) and fasten with oval head screw (9).
3. Feed cable of glow plug / flame sensor (11) through opening in shield.
4. Torque oval head screw (9) to  $0.8 \pm 0.08$  Nm.

5. Fit new seal (13) in groove of flange of heat exchanger (14).
6. Position burner tube (12) for assembly and fasten with Torx screws (16).
7. Torque screws to  $4.0 \pm 0.4$  Nm.
8. Hold burner with shield (17) upside down, engage burner tube (12) and rotate to assemble with combustion tube.
9. Fasten shield and burner tube (12) with EJOT FDS screws SF (10).
10. Torque EJOT FDS screws SF (10) to  $2.5 \pm 0.25$  Nm.
11. Push grommet of fuel supply into housing of heat exchanger (14).
12. Feed cable of glow plug / flame sensor (11) through heat exchanger and plug grommet.
13. Mount combustion and heating air fan (see 9.2.5.2).
14. Install control unit (see 9.2.4.2).
15. Fit insulation mat (15).
16. Refit housing components / covers.



9.2 Disassembly and Assembly

9.2.1 Housing Components / Covers, Removal

9.2.1.1 Cover for Electrical Connection

The wiring harness leaves the heater either on the left or right side depending on installation conditions. The cover (1, Fig. 901) may be levered off on both sides with a blunt blade in the areas (X) and can then be pulled off.

9.2.1.2 Covers for Heating Air Inlet and Outlet

Both covers (3 and 5, Fig. 901) may be unlocked from arrested position and removed by pressing in the locking tabs (top and bottom).

9.2.1.3 Upper Housing Shell

The upper housing shell (2, Fig. 901) may be lifted after removal of the covers for the heating air inlet and outlet.

9.2.1.4 Lower Housing Shell

An easy pull on both sides of the lower shell (4, Fig. 901) in the areas (Y) unlocks the shell from arrested position to be separated from the fan housing.

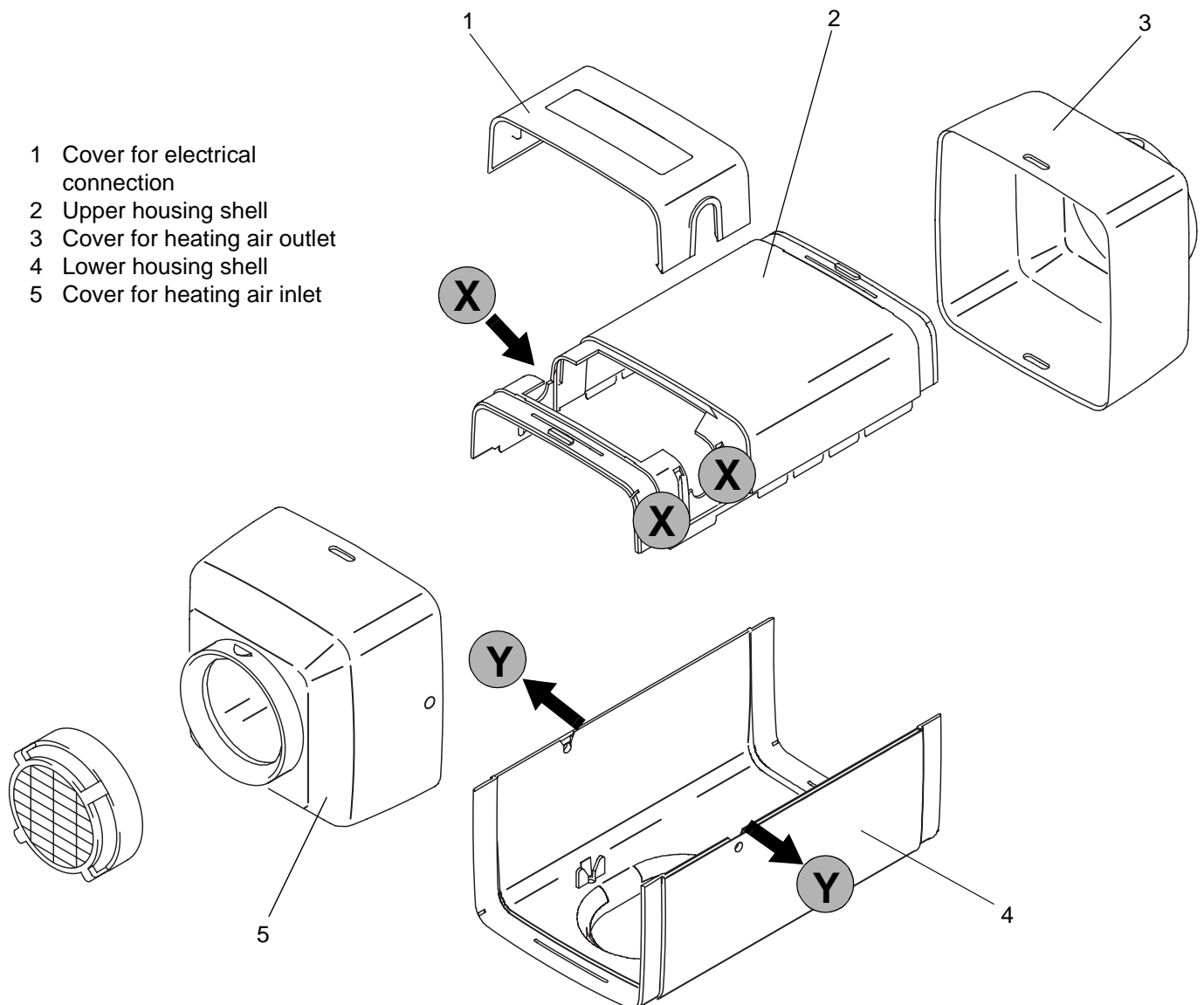


Fig. 901 Removal of Housing Components / Covers

### 9.2.2 Temperature Sensor, Replacement

#### NOTE

- The temperature sensor may be replaced without removal of the heater.
- The internal temperature sensor may be substituted against an external temperature sensor (see 9.1.2.1).

#### 9.2.2.1 Removal

1. Remove cover (1, Fig. 901).
2. Pull temperature sensor (5, Fig. 902) from control unit (1) and remove.
3. Perform procedures on components after disassembly (refer to 9.1.1).

#### 9.2.2.2 Installation

1. Plug temperature sensor (5, Fig. 902) into control unit.
2. Refit cover.

### 9.2.3 Temperature Limiter, Replacement

#### 9.2.3.1 Removal

1. Remove housing components/covers (see 9.2.1).
2. Remove insulation mat (15, Fig. 902).
3. Disconnect connector of temperature limiter (3) from control unit (1).

#### NOTE

The temperature limiter may be additionally fastened with a washer. This washer must be replaced with a new washer during installation.

4. Remove torx screw (4) and washer as required.
5. Remove temperature limiter (3).
6. Perform procedures on components after disassembly (refer to 9.1.1).

#### 9.2.3.2 Installation

#### CAUTION

The temperature sensor must be installed so that the sensor element faces the heat exchanger.

1. Position temperature limiter (3, Fig. 902) for installation and secure with torx screw (4) and washer as required.
2. Tighten screw (4) with  $2.5 \pm 0.25$  Nm.
3. Connect electrical connector of temperature limiter (3) to control unit (1).
4. Fit insulation mat (15).
5. Assemble housing components/covers.

### 9.2.4 Control Unit, Replacement

#### 9.2.4.1 Removal

1. Remove housing components/covers (see 9.2.1).
2. Remove insulation mat (15, Fig. 902).
3. Disconnect all connectors from control unit (1).
4. Remove torx screws (2).
5. Slide control unit (1) towards fan and remove.
6. Perform procedures on components after disassembly (refer to 9.1.1).

#### 9.2.4.2 Installation

1. Position control unit (1, Fig. 902) for installation on combustion and heating air fan (7), slide towards fan housing and secure with torx screws (2).
2. Tighten screws with  $3.0 \pm 0.3$  Nm.
3. Connect all electrical connectors to control unit (1).
4. Fit insulation mat (15).
5. Assemble housing components/covers.

### 9.2.5 Combustion and Heating Air Fan (Drive), Replacement

#### NOTE

The drive (combustion and heating air fan) may only be replaced as complete assembly. Repair is not possible.

#### CAUTION

The drive must only be replaced by a drive with the same nameplate rating and the same ident.-no.

#### 9.2.5.1 Removal

1. Remove housing components/covers (see 9.2.1).
2. Remove insulation mat (15, Fig. 902).
3. Remove gasket (16).
4. Remove control unit (see 9.2.4.1).
5. Remove torx screws (6).
6. Withdraw and remove combustion and heating air fan (7).
7. Remove flat gasket (8) and discard.
8. Perform procedures on components after disassembly (refer to 9.1.1).

#### 9.2.5.2 Installation

1. Place new flat gasket (8, Fig. 902) onto flange of heat exchanger (14).
2. Position combustion and heating air fan (7) for installation and secure with torx screws (6).
3. Tighten screws with  $4.0 \pm 0.4$  Nm.
4. Install control unit (see 9.2.4.2).
5. Fit insulation mat (15).
6. Refit housing components / covers.
7. Fit seal (16).

#### HINWEIS

Adjust CO<sub>2</sub> contents according to 6.2.1.

## 9.2.6 Glow Plug / Flame Sensor, Replacement

### 9.2.6.1 Removal

1. Remove housing components / covers (see 9.2.1).
2. Remove insulation mat (15, Fig. 902).
3. Remove control unit (see 9.2.4.1).
4. Remove combustion and heating air fan (see 9.2.5.1).

#### NOTE

Perform steps 5 through 10 for a burner (19) without shield. Steps 11 through 14 refer to an installed burner with shield (18).

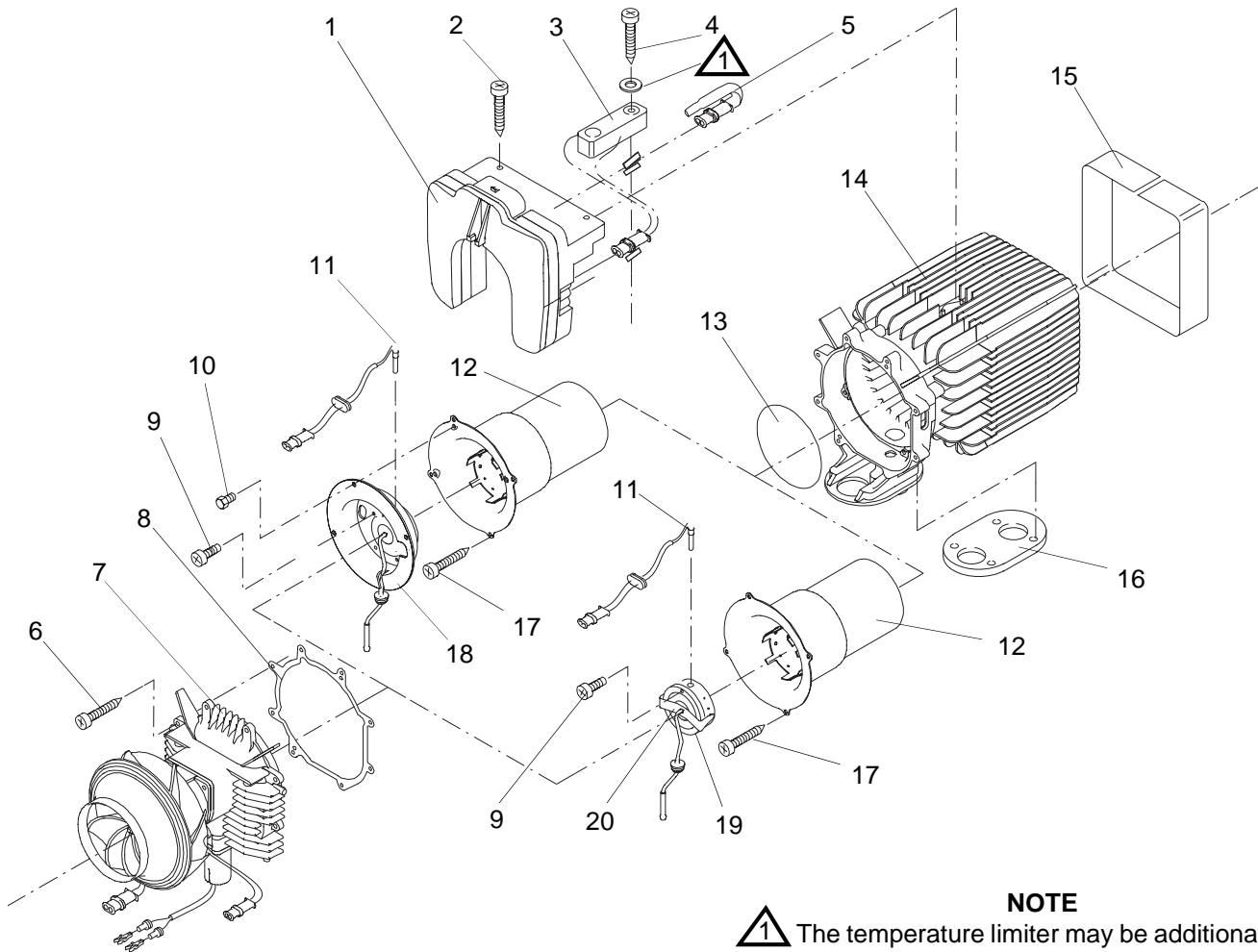
5. Loosen (lever off) fastening clamp (20) of burner (19).
6. Push grommet of glow plug / flame sensor (11) out of housing of heat exchanger (14).
7. If required carefully bend up fastening clip for cable of glow plug / flame sensor (11) located on burner tube (12).
8. Withdraw burner (19).
9. Remove oval head screw (9).
10. Withdraw glow plug / flame sensor (11) from burner (19) and remove.
11. Remove EJOT FDS screws SF (10).
12. Push grommet of glow plug / flame sensor (11) out of housing of heat exchanger (14) and withdraw burner with shield (18) from burner tube (12).
13. Remove oval head screw (9).
14. Withdraw glow plug / flame sensor (11) from burner with shield (18) and remove.
15. Perform procedures on components after disassembly (refer to 9.1.1).

### 9.2.6.2 Installation

#### NOTE

Steps 1 through 5 to be performed for a burner (19, Fig. 902) without shield. Steps 6 through 13 refer to an installed burner with shield (18).

1. Insert glow plug / flame sensor (11) into burner (19) (cable in direction of opening for cable grommet) and secure with oval head screw (9).
2. Tighten oval head screw with  $0.8 \pm 0.08$  Nm.
3. Locate burner for installation and press grommet of glow plug / flame sensor (11) into housing of heat exchanger (14). Bend down fastening clip as required.
4. Route cable of glow plug / flame sensor (11) below fastening clip and through opening in housing of heat exchanger (14).
5. Secure burner (19) in position using fastening clamp (20).
6. Insert glow plug / flame sensor (11) in burner with shield (18) (cable routed towards opening for cable grommet in shield) and fasten with oval head screw (9).
7. Feed cable of glow plug / flame sensor (11) through opening in shield.
8. Torque oval head screw (9) to  $0.8 \pm 0.08$  Nm.
9. Hold burner with shield (18) upside down, engage burner tube (12) and rotate to assemble with combustion tube.
10. Push grommet of fuel supply into housing of heat exchanger (14).
11. Fasten shield and combustion tube (12) with EJOT FDS screws SF (10).
12. Torque EJOT FDS screws SF (10) to  $2.5 \pm 0.25$  Nm.
13. Feed cable of glow plug / flame sensor (11) through heat exchanger and plug grommet.
14. Install combustion and heating air fan (see 9.2.5.2).
15. Install control unit (see 9.2.4.2).
16. Fit insulation collar (15).
17. Refit housing components / covers.



**NOTE**  
 1 The temperature limiter may be additionally fastened with a washer. This washer must be replaced with a new washer during installation.

- |                                  |                             |
|----------------------------------|-----------------------------|
| 1 Control unit                   | 11 Glow plug / flame sensor |
| 2 Torx screw (2)                 | 12 Burner tube              |
| 3 Temperature limiter            | 13 Seal                     |
| 4 Torx screw                     | 14 Heat exchanger           |
| 5 Temperature sensor             | 15 Insulation mat           |
| 6 Torx screw (8)                 | 16 Seal                     |
| 7 Combustion and heating air fan | 17 Torx screw (4)           |
| 8 Flat gasket                    | 18 Burner with shield       |
| 9 Oval head screw                | 19 Burner                   |
| 10 EJOT FDS screw SF (3)         | 20 Fastening clamp          |

Fig. 902 Disassembly and Assembly

## 9.2.7 Burner, Replacement

### 9.2.7.1 Removal

1. Remove housing components / covers (see 9.2.1).
2. Remove insulation mat (15, Fig. 902).
3. Remove control unit (see 9.2.4.1).
4. Remove combustion and heating air fan (see 9.2.5.1).

#### NOTE

Perform steps 5 through 11 for a burner (19) without shield. Steps 12 through 16 refer to an installed burner with shield (18).

5. Loosen (lever off) fastening clamp (20) of burner (19).
6. Push grommet of fuel supply line out of housing of heat exchanger (14).
7. If required carefully bend up fastening clip for cable of glow plug / flame sensor (11) located on burner tube (12).
8. Withdraw burner (19).
9. Remove oval head screw (9).
10. Withdraw glow plug / flame sensor (11) from burner (19).
11. Remove burner (19).
12. Remove EJOT FDS screws SF (10).
13. Push grommet of glow plug / flame sensor (11) out of housing of heat exchanger (14) and withdraw burner with shield (18) from burner tube (12).
14. Remove oval head screw (9).
15. Withdraw glow plug / flame sensor (11) from burner with shield (18).
16. Remove burner with shield (18).
17. Perform procedures on components after disassembly (refer to 9.1.1).

### 9.2.7.2 Installation

#### NOTE

Perform steps 1 through 5 for a burner (19, Fig. 902) without shield. Steps 6 through 13 refer to an installed burner with shield (18).

1. Insert glow plug / flame sensor (11) into burner (cable in direction of opening for cable grommet) and secure with oval head screw (9).
2. Tighten oval head screw (9) with  $0.8 \pm 0.08$  Nm.
3. Locate burner (19) for installation and press grommet of fuel supply line into housing of heat exchanger (14).
4. Secure burner (19) in position using fastening clamp (20).
5. Route cable of glow plug/flame sensor (11) below fastening clip on burner tube (12). Bend down fastening clip as required.
6. Insert glow plug / flame sensor (11) in burner with shield (18) (cable routed towards opening for cable grommet in shield) and fasten with oval head screw (9).
7. Feed cable of glow plug / flame sensor (11) through opening in shield.

8. Torque oval head screw (9) to  $0.8 \pm 0.08$  Nm.
9. Hold burner with shield (18) upside down, engage burner tube (12) and rotate to assemble with combustion tube.
10. Push grommet of fuel supply into housing of heat exchanger (14).
11. Fasten shield and combustion tube (12) with EJOT FDS screws SF (10).
12. Torque EJOT FDS screws SF (10) to  $2.5 \pm 0.25$  Nm.
13. Feed cable of glow plug / flame sensor (11) through heat exchanger and plug grommet.
14. Install combustion and heating air fan (see 9.2.5.2).
15. Install control unit (see 9.2.4.2).
16. Fit insulation mat (15).
17. Refit housing components / covers.

## 9.2.8 Burner Tube, Replacement

### 9.2.8.1 Removal

1. Remove housing components / covers (see 9.2.1).
2. Remove insulation mat (15, Fig. 902).
3. Remove control unit (see 9.2.4.1).
4. Remove combustion and heating air fan (see 9.2.5.1).
5. Remove burner (see 9.2.7.1).
6. Remove torx screws (17).
7. Withdraw and remove burner tube (12).
8. Remove and discard sealing ring (13).
9. Perform procedures on components after disassembly (refer to 9.1.1).

### 9.2.8.2 Installation

1. Place new sealing ring (13, Fig. 902) into groove on flange of heat exchanger.
2. Locate burner tube (12) for installation and secure with torx screws (17).
3. Torque tighten screws to  $4.0 \pm 0.4$  Nm.
4. Install burner (see 9.2.7.2).
5. Install combustion and heating air fan (see 9.2.5.2).
6. Install control unit (see 9.2.4.2).
7. Fit insulation collar (15).
8. Assemble housing components / covers.



**9.2.9 Heat Exchanger, Replacement****CAUTION**

Replacement of heat exchanger requires additional replacement of temperature limiter.

**9.2.9.1 Removal**

1. Remove housing components / covers (see 9.2.1).
2. Remove insulation mat (15, Fig. 902).
3. Remove control unit (see 9.2.4.1).
4. Remove combustion and heating air fan (see 9.2.5.1).
5. Remove burner (see 9.2.7.1).
6. Remove burner tube (see 9.2.8.1).
7. Perform procedures on components after disassembly (refer to 9.1.1).

**9.2.9.2 Installation**

1. Install burner tube (see 9.2.8.2).
2. Install burner (see 9.2.7.2).
3. Install combustion and heating air fan (see 9.2.5.2).
4. Install control unit (see 9.2.4.2).
5. Fit insulation mat (15).
6. Assemble housing components / covers.