

Boat Air Heating Systems

Marine Heater Installation Instructions

Air Top 2000 ST

Trade names: Air Top 2000 ST D (Diesel/PME) (diesel/PME)

/// BUTLER TECHNIK



Das unsachgemäße Einbauen oder Reparieren von Webasto Heiz- und Kühlsystemen kann Feuer verursachen oder zum Austritt von tödlichem Kohlenmonoxid führen. Dadurch können schwere oder tödliche Verletzungen hervorgerufen werden.

Für den Einbau und die Reparatur von Webasto Heiz- und Kühlsystemen bedarf es eines Webastotrainings, technischer Dokumentation, Spezialwerkzeuge und einer Spezialausrüstung.

Es dürfen nur Originalteile von Webasto verwendet werden. Siehe dazu auch Zubehörkatalog Luft- und Wasserheizgeräte von Webasto.

Versuchen Sie NIEMALS, Webasto Heiz- oder Kühlsysteme einzubauen oder zu reparieren, wenn Sie das Webastotraining nicht erfolgreich abgeschlossen und dabei die notwendigen technischen Fähigkeiten erworben haben und die für einen sachgerechten Einbau und Reparatur nötigen technischen Dokumentationen, Werkzeuge und Ausrüstungen nicht zur Verfügung stehen.

Befolgen Sie IMMER alle Webasto Einbau- und Reparaturanleitungen, und beachten Sie alle Warnhinweise.

Webasto übernimmt keine Haftung für Mängel und Schäden, die auf einen Einbau durch ungeschultes Personal zurückzuführen sind.



Improper installation or repair of Webasto heating and cooling systems can cause fire or the leakage of deadly carbon monoxide leading to serious injury or death.

To install and repair Webasto heating and cooling systems you need to have completed a Webasto training course and have the appropriate technical documentation, special tools and special equipment.

Only genuine Webasto parts may be used. See also Webasto air and water heaters accessories catalogue.

NEVER try to install or repair Webasto heating or cooling systems if you have not completed a Webasto training course, you do not have the necessary technical skills and you do not have the technical documentation, tools and equipment available to ensure that you can complete the installation and repair work properly.

ALWAYS carefully follow Webasto installation and repair instructions and heed all WARNINGS.

Webasto rejects any liability for problems and damage caused by the system being installed by untrained personnel.



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1 Safety Precautions

1.1. Symbols used



Particular risk of injury or fatal accidents



Legal regulations and technical documentation



Danger of fire and explosion



Reference to a special technical feature



Recommendations

- Always observe the following: applicable accident prevention regulations and workshop and work safety instructions.
- Observe regulations of regional government agencies! Clarify which regulations apply in the planned area of use of the boat. Take these into account! Obtain an official government permit if necessary!
- Observe all warnings!
- Comply with the technical rules!
- Repairs not carried out properly or without genuine Webasto spare parts will lead to the warranty being voided by Webasto. This will result in the homologation approval of the heater unit being voided.
- Only use heater controls approved by Webasto! Otherwise, there is a risk of malfunctions occurring!
- See the Webasto accessories catalogue for accessories, installation and assembly parts.
- The installation examples shown in this documentation are for information purposes only.
No liability claims can be derived from the installation examples shown.



WARNING!

*When positioning the exhaust outlet, always prevent the re-entry of the exhaust gases into the heating air system or the accommodation areas!
Danger of suffocation!*



WARNING!

*Never extract combustion air from the accommodation areas!
Danger of suffocation!!*



WARNING!

The heating unit must be switched off while refuelling!



WARNING!

*Use only fire-resistant fuel lines and temperature-resistant, thermally insulated heating air hoses!
Fire danger!!*



WARNING!

Do not blow hot air directly onto living creatures or temperature-sensitive parts!



2 General

Using heater units

Solely for use on ships:

- For pre-heating and heating of ship's cabins, cargo holds, passenger and crew transport areas
- On inland waters and at sea
- For sailing and motor boats of approximately 8 to 24 m in length

Not suitable for:

- Continuous heating of living areas, houseboats, etc.!
- For heating and/or drying living creatures

Permits

Existing homologation approvals for Air Top heater units in accordance with EC Directives 72/245/EEC (electromagnetic compatibility) and 2001/56/EC (heating) with the following homologation approval numbers:

Air Top 2000ST:

- e1*72/245*2009/19*1085 (electromagnetic compatibility)
- e1*2001/56*2006/119*0022 (heating)
- E1 00 0216 (heating)

Air Top Evo 3900/5500:

- e1*72/245*2006/96*5529 (Air Top Evo 3900 / 5500)
- E1 03 5529 (Air Top Evo 3900 / 5500)
- e1*2001/56*2006/119*0255 (Air Top Evo 3900)
- E1 00 0255 (Air Top Evo 3900)
- e1*2001/56*2006/119*0256 (Air Top Evo 5500)
- E1 00 0256 (Air Top Evo 5500)

The regulations of the Directive 2001/56/EC and ECE R-122 must be observed for installation.

CE symbol (prescribed in EU for new recreational craft from 2.5 to 24 m in length).

Relevant standards for installation

- Recreational Craft Directive 94/25/EC
- ISO 8845/46 - Protection against ignition of surrounding flammable gases
- ISO 7840 - Fire-resistant fuel hoses
- ISO 9094 - Fire protection for small craft

2.1. Mode of operation

The air heater in the locker draws in outside air through the intake opening with an integrated fan. The air heated in the heater unit flows into the bow through connected warm air hoses. The warm air enters the cabins at the air outlets.

Fuel is supplied from the boat's fuel tank with a separate metering pump.

Power is supplied (for fan, electronics, etc.) from the boat's battery.

The combustion circuit is separated from the heating circuit. This results in a separate combustion air intake.

The exhaust gas is routed to the outside via the exhaust system including silencer.

The interior temperature is adjusted to the selected value with a cabin temperature sensor and the heater control.

The heater unit constantly compares the actual and the selected temperature and automatically adjusts the heating capacity accordingly.

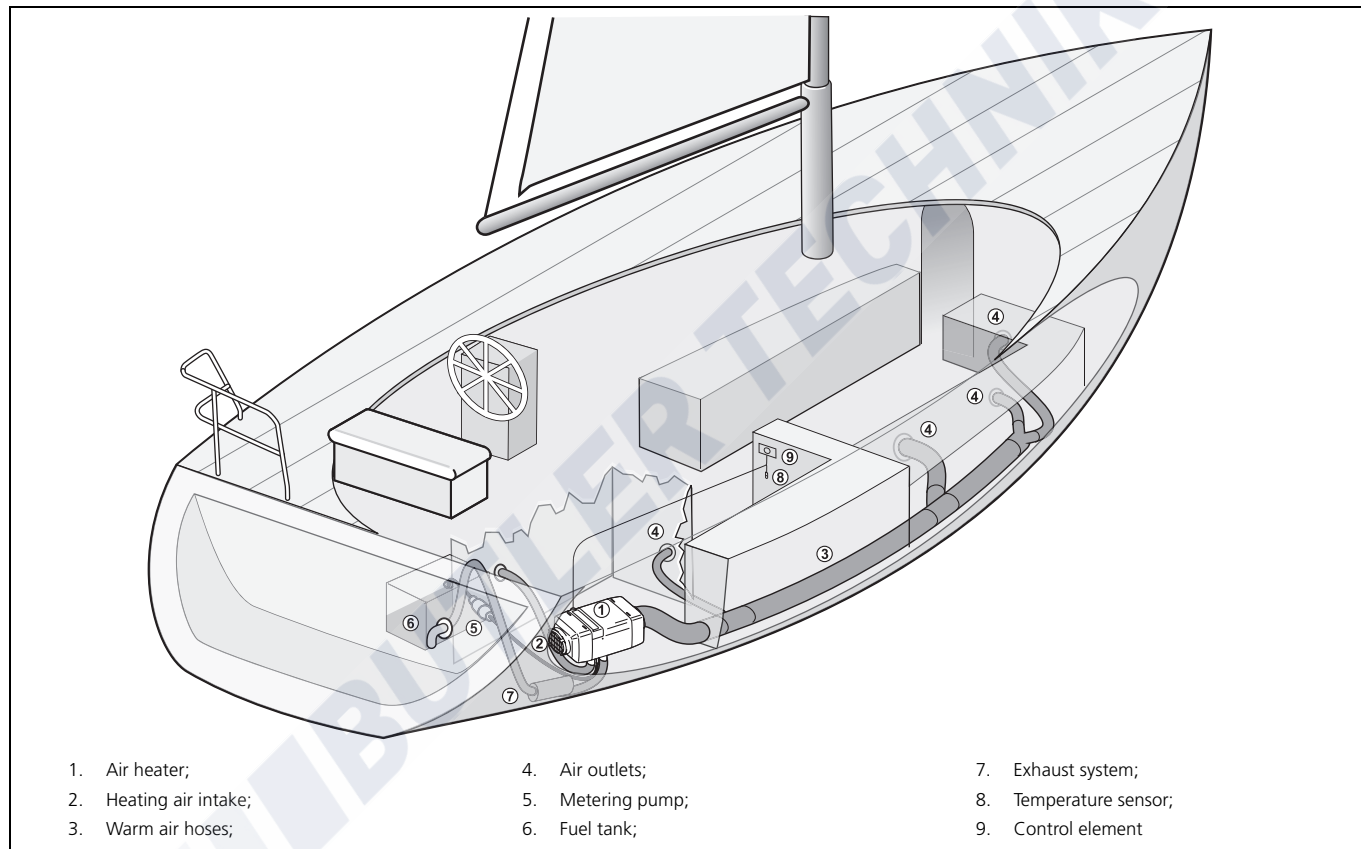


Fig. 1: Example of a sailing yacht

Installing Heater Unit

3 Installing Heater Unit

3.1. Choosing installation location

WARNING!

*Do not install heater unit and exhaust system in accommodation areas!
(Danger of suffocation in case of improper installation)*

- Install the heater unit in a dry location, protected from the ingress of sea water, excessive vibrations, heat, engine exhaust gases and soiling by fuel or oil (requirement from 2001/56/EC).
- Design the installation to suit the requirements and type of boat. Take the following into account: all peripheral components, such as the maximum permissible exhaust system length, the position of the exhaust through hull, the combustion air intake, the routing of electrical wiring and cable lengths, the distance from the fuel tank, the routing of the warm air hoses, the fresh air intake, etc.
- Take the following into account: The maximum inclination of the ship may not result in the ingress of sea water through the exhaust outlet.
- The inclination may not cause the heater unit to come into contact with bilge water.
- No obstruction of moving parts (e.g. rudder assembly)!
- Every reasonable precaution should be taken in positioning the heater to minimise the risk of injury and damage to personal property (requirement from 2001/56/EC).

Fire danger: Heater unit can overheat!



- Ensure sufficient spacing to all parts and sufficient ventilation!
- Use only fire-resistant materials!
- Install heat shields if necessary!
- Do not install in the vicinity of flammable or temperature-sensitive objects, such as sails, fenders, bulkheads, paper, gas lines, fuel containers, etc.
- When installing in locker or rudder box:
 - Only with good ventilation
 - Prevent contact with hot parts
 - Install a contact barrier around the heating system if necessary!

- Recommendation on installation location:
 - In locker or rudder box if they are well ventilated.
Install a contact barrier around the heating system so that sails, fenders, bulkheads, etc. do not come into contact with hot parts!
 - In the engine compartment of inboard diesel engines. Condition: Heating air intake from outside, combustion air intake from outside or from engine compartment if this is well ventilated to the outside!

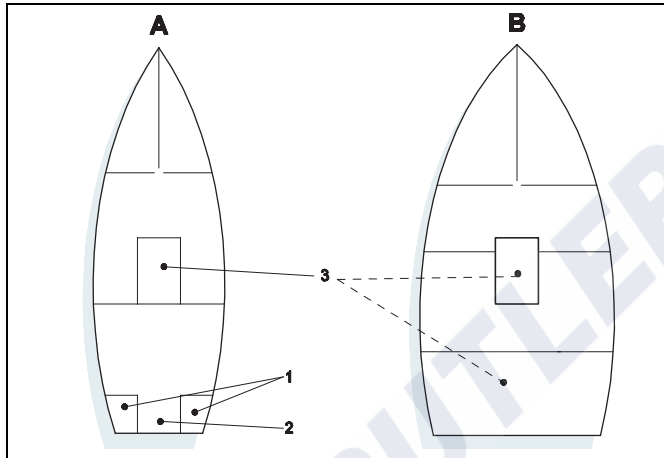


Fig. 2: Installing heater unit in locker (1), rudder box (2) or engine compartment (3)

3.2. Heating unit dimensions

The installation dimensions and the space requirements for maintenance accessibility are shown in Figure 3.

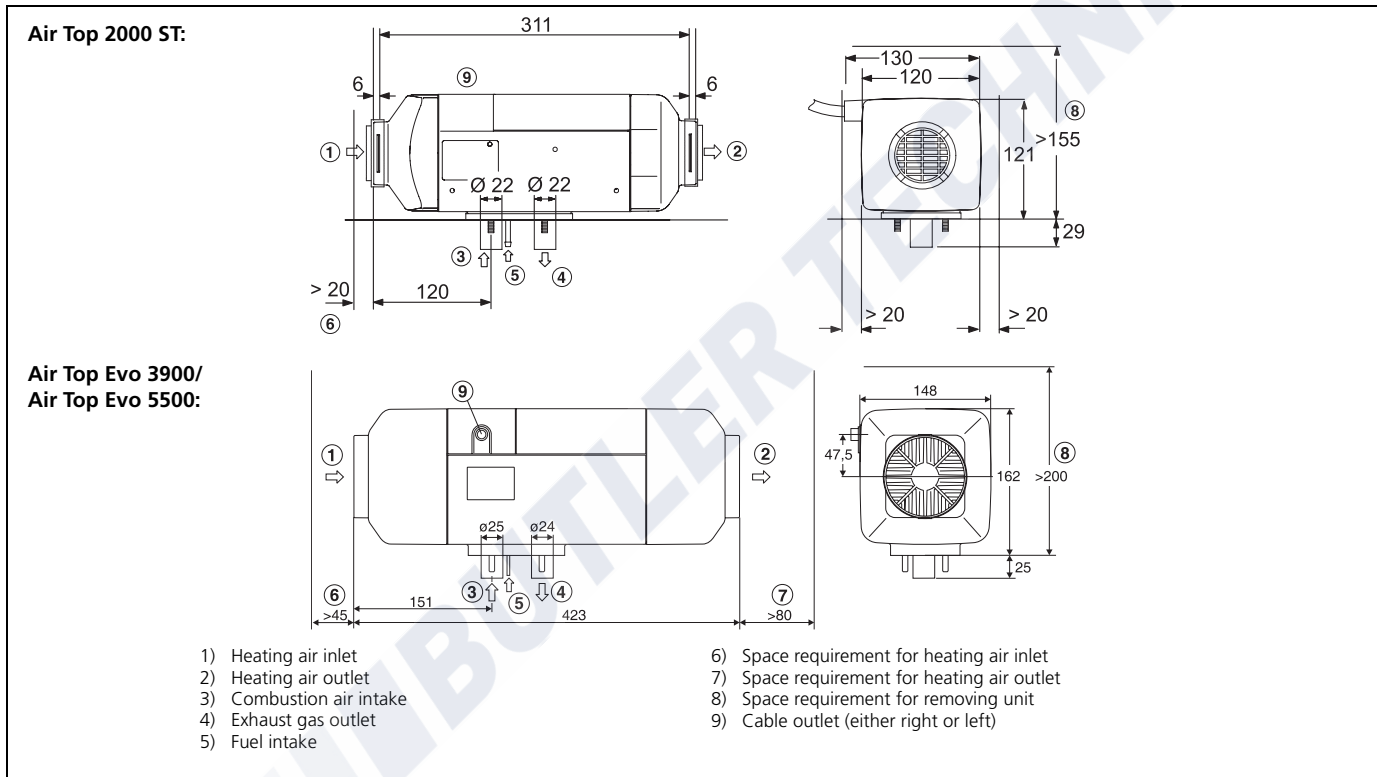


Fig. 3: Heating unit dimensions

3.3. Unit orientation

The specified horizontal and axial angles must not be exceeded.

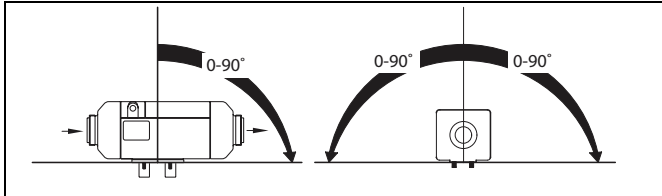


Fig. 4: Permissible installation positions for Air Top Diesel air heater units

- Installation positions: observe possible inclination of ship!
- Recommended installation position: Exhaust outlet routed downward; heater unit parallel to ship's longitudinal axis.
- Do not install transversely in sailboats!
Exception: if heater unit is primarily operated when boat is moored, or in motorboats then installation transverse to longitudinal axis is also permissible.

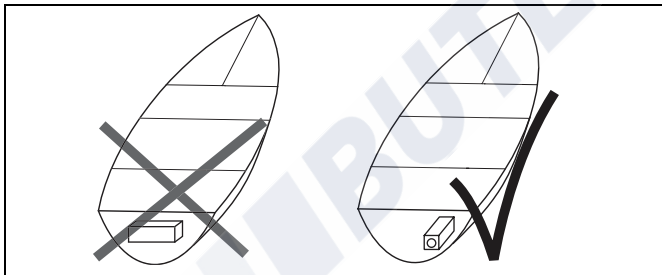


Fig. 5: Install heater unit in longitudinal direction in sailboats!

3.4. Heater unit mounting

- Securely mount the unit (vibrations, swells)!
- Use the bracket and rubber gasket provided under the unit base.
- This rubber gasket must be replaced each time the heater unit is installed.
- The M6 nuts must be tightened to 6 Nm (–0 Nm, +1 Nm) to mount the unit base.

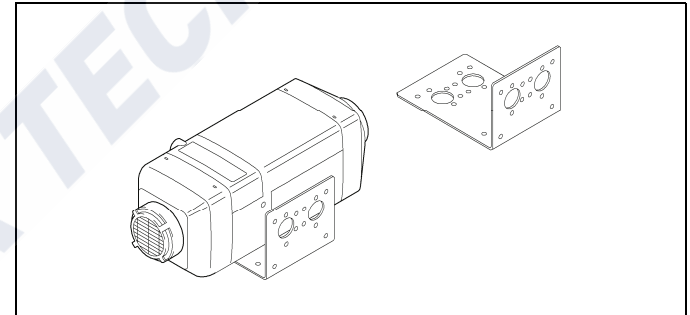


Fig. 6: Mounting Air Top with angled retaining bracket

After installation, check that the casing is not in contact with any parts of the vehicle body. A failure to do this may result in the blocking of the heating air fan.

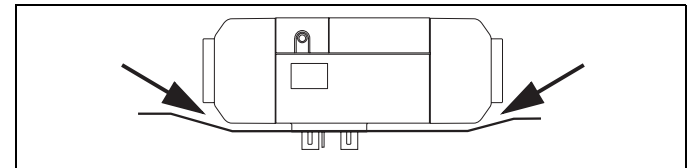


Fig. 7: Ensure that all moving parts can move easily.

Installing Heater Unit

- Recommendation: elastic mounting (vibration decoupling, noise reduction)!
- Screw the heater unit onto the bracket with bolts.
- Recommendation when mounting on outer skin of FRP boats: laminate on a wooden sheet at the fastening location from the inside to prevent drilling through the outer wall.



WARNING!

There is a danger of drowning when drilling into the ship's outer skin! Drilling below the water line can cause the ship to sink!



If the boat is in the water: check the drilling location! Have leak sealing equipment available beforehand and familiarise yourself with possible escape routes!

4 Exhaust

4.1. Exhaust system

Route the combustion gases out of the boat via the exhaust system.

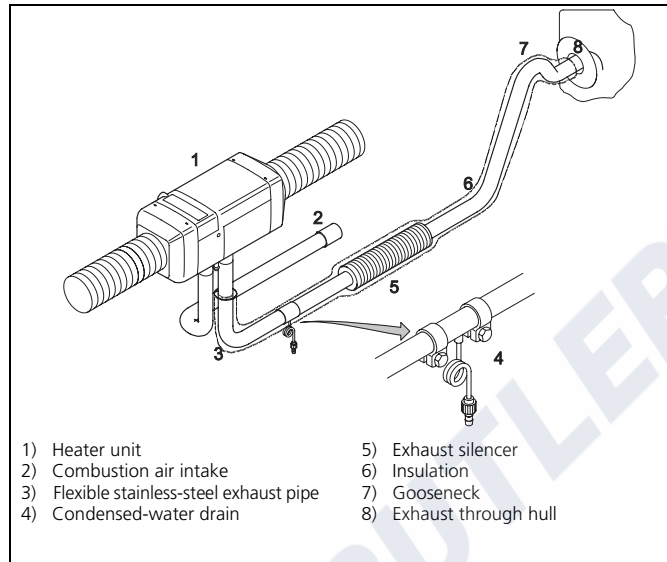


Fig. 8: Exhaust system

4.2. Exhaust outlet

Outlet arrangement:

- Position the exhaust outlet where no splash-water can enter the boat.
Recommendation:
Sailboats: on stern transom.
Motorboats: on side wall.

CAUTION!

Do not position the exhaust outlet below or next to ventilation equipment, window openings or the heating air inlet (otherwise danger of suffocation)!



- At least 60 cm above the water line so that no water can enter when the boat heels
- Do not connect to the engine or generator exhaust system (higher pressures; damage to heater unit!)
- Not in the direction of movement of the boat (high wind pressure)
- Not where it can easily be covered, e.g. by the fender.

Exhaust through hull:

- Choice of design and installation position: Minimisation of rain water ingress!
- User only genuine Webasto exhaust through hulls! Fit insulating washers exactly for thermal insulation from the side wall (minimisation of water ingress)!
If additional sealing is required: use only heat-resistant sealing compound!
- Exhaust through hull: Not closeable; not with self-opening valves!

- Mount exhaust through hull with pipe socket angled facing upward.

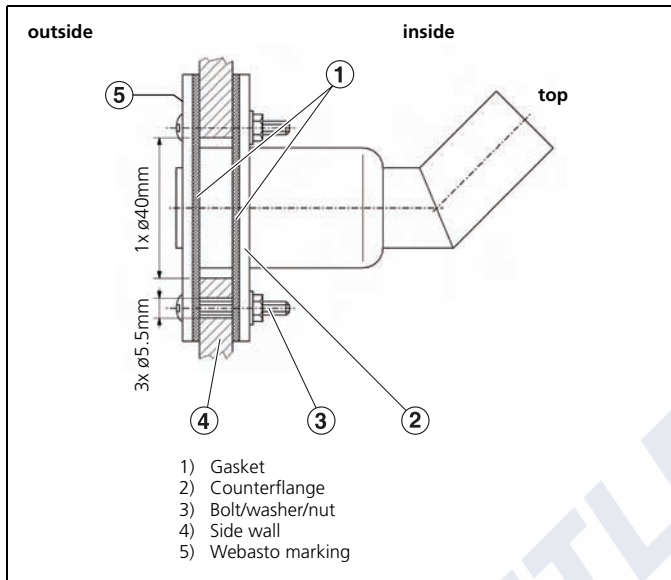


Fig. 9: Exhaust through hull

4.3. Exhaust pipe

4.3.1. Exhaust pipes

- Keep the exhaust pipe as short as possible.
- Route the exhaust pipe as straight as possible (permissible total bends $< 270^\circ$; smallest permissible bending radius 50 mm)!
- No contact with/ sufficient spacing to temperature-sensitive objects, such as electrical cables, water pipes, plastic parts, sails or boat hull!
- Minimum distance from wall: $\geq 20\text{ mm}$!
- Minimum pipe diameter: 24 mm.

4.3.2. Length from exhaust to combustion-air pipe

The following maximum total lengths of the combustion air intake and exhaust pipe must be complied with for Air Top 2000 ST, Air Top Evo 3900/5500:

- with boat exhaust silencer: max. 2.5 m
- without exhaust silencer: max. 5.0 m

4.3.3. Exhaust pipes in accommodations

WARNING!

*Do not install heater unit and exhaust system in accommodation areas!
(Danger of suffocation in case of improper installation)*



- If this is unavoidable: use rigid stainless-steel pipes with a wall thickness of ≥ 1 mm!
- Replace pipes with new ones after ≤ 10 years!
- Do not position detachable connection points in accommodation areas!
- Use sealing compound resistant to high temperatures!

4.4. Exhaust pipe connections

- When routing the exhaust system, make sure: all connections are leak-tight!
- Use only hose clamps approved by Webasto!
Never use hose clips!

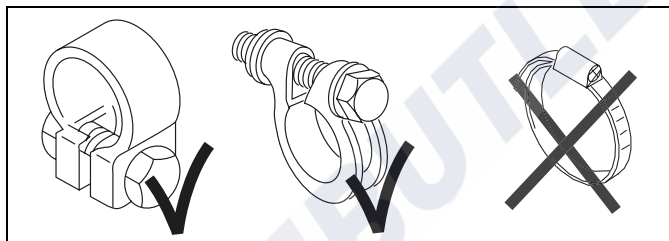


Fig. 10: Approved hose clamps for mounting exhaust pipes

4.5. Thermal insulation

Observe the following when routing the exhaust system:

- Avoid contact between the hot exhaust system and temperature-sensitive objects, such as electrical cables, water pipes, plastic parts, sails or the boat hull!
- If contact with persons/objects is possible during heating: Insulate the exhaust pipe or fit shielding. Use suitable exhaust-gas insulation: see the Webasto accessories catalogue.



Fig. 11: Exhaust insulating hose

- Surface temperature ≤ 80 °C !
- Minimum distance from walls ≥ 20 mm.

4.6. Gooseneck

Last section of the exhaust pipe: gooseneck sloping downward to the outlet (due to possible ingress of water).
Height of the gooseneck: ≥ 20 cm.



4.7. Condensed-water drain

With an exhaust pipe length > 2 m, fit a condensed-water drain (non-rusting).

- A) With a T-piece at the lowest point in the exhaust system or
- B) If the heater unit itself is at the lowest point: use an exhaust connection piece with an integrated condensed-water drain. Suitable components: see Webasto accessories catalogue.

Use a catch container or a drain hose for condensed water if necessary.

The condensed-water drain connection piece is available in various designs.

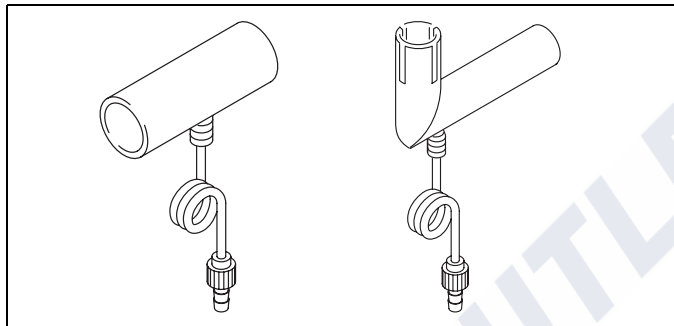


Fig. 12: Condensed-water drain connection piece

4.8. Silencer

Use the genuine Webasto exhaust silencer provided. It results in a considerable noise reduction. The direction of flow and installation position can be chosen as desired. For a good damping effect, mount the muffler as close as possible to the heater unit (approx. 0,5 m).



Do not drill a condensed-water drain hole in the muffler (exhaust will escape).

The exhaust silencer itself must be fastened every 50 cm directly to fixed parts of the boat with a clamp to prevent impermissible vibrations.

The heater unit may also be operated without a silencer.

Suitable models: see Webasto accessories catalogue.

5 Combustion air supply

5.1. Combustion air circulation

Always observe the following:

- Intake from an area well ventilated to outside at ambient pressure and/or directly from outside

WARNING:

Do not extract combustion air from accommodation areas/ cabins! Danger of suffocation!



- Intake location: no intake of exhaust gases from heater unit and/or engine!

5.1.1. Intaking combustion air from an area well ventilated to outside (locker, storage area or engine compartment)

- No exhaust through hull required
- Intake area must be at ambient pressure and sufficiently ventilated to the outside.
- When intake is from the engine compartment: the ventilation fan of the engine compartment may not produce any gauge pressure or vacuum in the engine compartment.

5.1.2. Intaking combustion air directly from outside

- Use separate exhaust through hull if intake from a ventilated area is not possible.
- Design the end of the intake hose as a gooseneck as shown. Prevent water from entering through the intake opening.

- Do not position the exhaust through hull in the direction of travel (otherwise backpressure and water ingress in the intake pipe are possible).
- Drill a drain hole at the lowest point as shown.
- Route the hose kink-free.

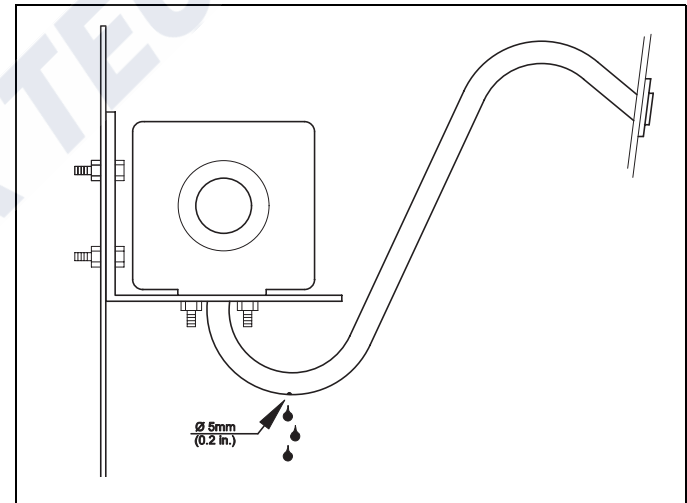


Fig. 13: Combustion air intake from outside through a exhaust through hull.

5.2. Intake hose

- Ensure downhill routing from the heater unit or drill a 5 mm dia. condensed water opening at the lowest point or use a separate condensed-water drain, see Figure 13.
- Fit a cap over the end of the hose as protection against ingress (if no exhaust through hull is used).
- Air inlet arrangement: cannot be blocked by objects (requirement from 2001/56/EC).
- Keep intake hose as short as possible.
For permissible lengths, see Section 4.3.2.
- Fasten the intake hose: with a hose clamp on the intake connection piece of the heater unit and with pipe clamps or cable ties on fixed built-in parts.
- Recommendation: Use intake silencers (intake noise).
Supplied with Air Top heater units.
With an intake hose length < 0.6 m, an intake silencer is mandatory.
- Please note: if the metering pump cable is routed out of the intake connection piece, prevent pinching off the cable when installing the intake hose. Do not use metal intake hoses.
- Route the hose kink-free.



6 Fuel Supply

- During installation, be sure to observe: national or local guidelines. Ask your local authorised Webasto partner if necessary.
- The fuel filler neck may not be located in the interior of the boat and must be provided with a well-sealing cap to prevent fuel from escaping (requirement from 2001/56/EC).
- If the heater unit takes the fuel from a separate additional tank, then the fuel type and the filler neck must be clearly marked (requirement from 2001/56/EC).
- A notice, indicating that the heater must be shut down before refuelling, must be affixed to the fuelling point (requirement from 2001/56/EC).
- Protect the boat hull/components in the vicinity of the heater unit against the effect of heat/contamination by fuel/oil.

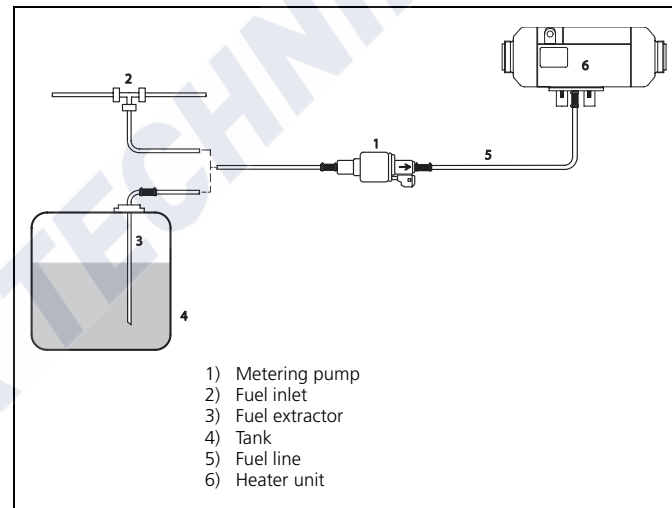


Fig. 14: Example of Air Top heater fuel supply

Fuel Supply

6.1. Pipe lengths and lifting height

The fuel is taken from the boat fuel tank or from a separate fuel tank. The values for the maximum pressure at the fuel extraction point are shown in Figure 15.

Be sure to observe the maximum permissible fuel intake height and/or the lifting height for the metering pump during installation.

Permissible fuel feed height H [m]	At max. perm. pressure [bar] in fuel line
0.00	0.2
1.00	0.11
2.00	0.03
Permissible fuel intake height S [m]	At max. perm. vacuum [bar] in the fuel tank
0.00	-0.10
0.50	-0.06
1.00	-0.02

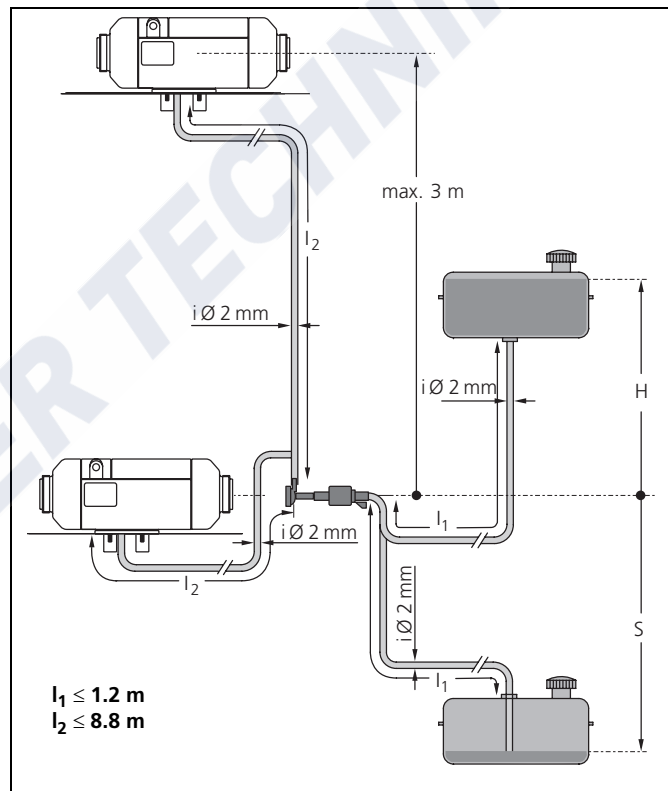


Fig. 15: Permissible pipe lengths and lifting heights

6.2. Fuel extraction

The following alternatives are available for extracting the fuel for the heater unit:

6.2.1. Fuel standpipe

- Fuel extraction directly from the boat's fuel tank.
- Plastic tanks: install the fuel standpipe in the tank fitting. Do not drill into a plastic tank.
- Suitable fuel standpipe for metal tanks: see the accessories catalogue and/or the delivery scope.

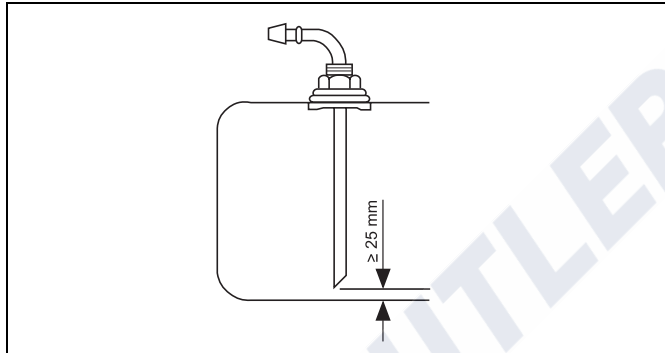


Fig. 16: Installing a fuel standpipe in metal tanks

Install the fuel standpipe as shown in Figure 16:

1. Shorten the immersion tube: the end should be approx. 25 mm above the bottom of the tank or high enough that fuel for the boat engine always remains in the tank. Cut the tube diagonally. Deburr the cut edges.

2. Drill a hole in the tank or tank fitting from above. Use a suitable drilling attachment. Grease the drill bit and drilling surface beforehand (to catch small drilling chips).
3. Guide the tank fitting into the hole and screw tight (the seal is slightly compressed).

6.2.2. Tank drain pipe

If an unused tank drain pipe is already fitted to the boat's tank, then use it. Do not use a tank drain screw located at the bottom of the tank, as contamination or water can be sucked in there.

6.2.3. Fuel extractor

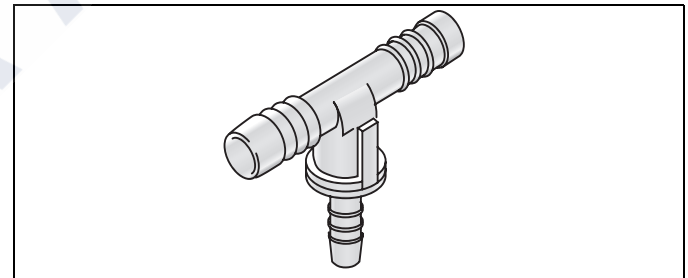


Fig. 17: Fuel extractor

The fuel extractor is a special T-piece with an integrated bubble separator. It can be installed in the supply line to the engine if no primary pump is available in the tank. Or in the return line from the engine if this reaches nearly to the bottom of the tank. When selecting the fuel extractor, note the diameters of the pipes present.

See the Webasto accessories catalogue for a suitable fuel extractor.

Fuel Supply

6.3. Fuel line

Fuel line material (metal/plastic): Observe the regional/national regulations!



Fire danger! In the engine compartment, fuel lines must be metal and connecting hoses between individual components must be made of fire-resistant material (in accordance with DIN-EN-ISO 7840).



For installation kits for metal fuel lines: see the accessories catalogue.

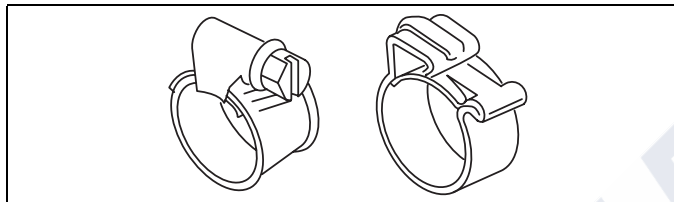


Fig. 18: Stainless-steel hose clamps

- Use only stainless-steel hose clamps to secure plastic lines.
- Metal pipes: make sure the work area is clean! Remove all contamination and burrs from the connection points prior to assembly.
- Do not over-tighten union nuts (otherwise leaks will occur).
- Route the fuel line as straight as possible and at a slight incline so that air bubbles escape toward the heater unit.
- Secure the line at regular distances to prevent sagging; avoid kinks.
- Keep away from heat sources. Use heat shielding if necessary!
- Inside dia. of fuel line = 2 mm; larger diameters result in malfunctions caused by gas bubbles.



6.4. Metering pump

The metering pump is controlled via a separate wiring harness and feeds the fuel into the combustion chamber of the heater unit depending on the required heating capacity. In the process, the separate metering pumps make a ticking noise due to the individual delivery strokes.

- Fit the metering pump near the tank. For the distance from the fuel standpipe, see Figure 15.
- Install the pump in a dry, cool area. Do not install in the bilge.
- Note the pump flow direction.
- Use an elastic mounting for the metering pump (reduces the transmission of structure-borne noise/ticking).

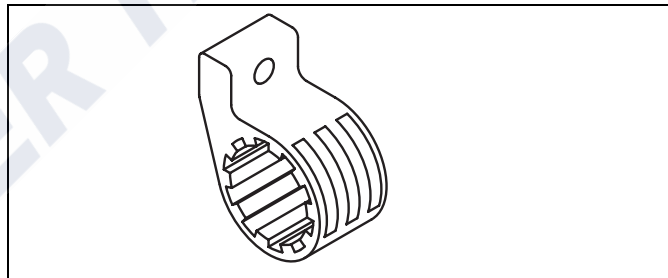


Fig. 19: Elastic mounting of metering pump

- Recommended installation: suspended from a solid boat component.
- Recommended fuel line mounting: Distance from metering pump ≥ 20 cm or in an elbow so that no structure-borne noise is conducted through the pipes.
- Fuel line mounting on wall (see Figure 20, top view) should not be too close to the metering pump.

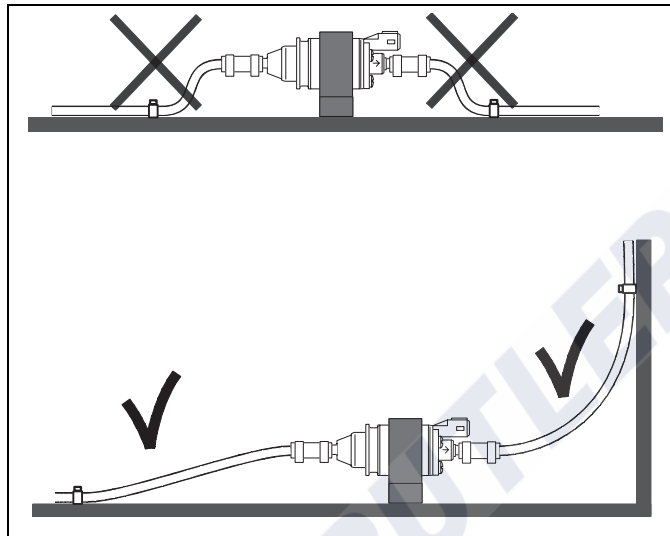


Fig. 20: Fuel line mounting

- Attach the metering pump horizontally.

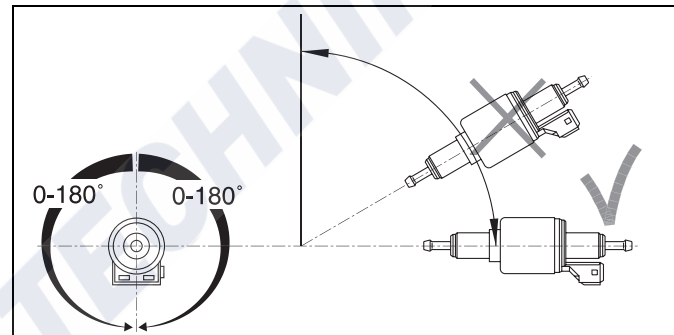


Fig. 21: Mounting orientation of metering pump for Air Top 2000 ST and Air Top Evo 3900/5500 diesel heating units

If the metering pump is equipped with a plastic fuel damper (e.g. Air Top 2000 ST Diesel), then it must be protected with a protective sleeve (see accessories catalogue) when being installed in the engine compartment.



6.5. Fuel filter

A fuel filter must be used as protection against soiling. Install upstream of the metering pump. If the filter is installed in the engine compartment, use only fire-resistant types in accordance with ISO 7840.



The direction of flow may not be downward, as otherwise no bubbles can escape.

6.6. Auxiliary tank

If an auxiliary tank is required for the heater unit fuel supply: it may only be installed by a specialist company for marine applications (with know-how on the required standards, regulations and directives).



6.7. Special information on petrol-driven heaters in boats

WARNING!

Petrol-driven heaters are not permitted in recreational boats covered by ISO 9094. Local regulations and special safety measures must be complied with!



Improper installation of a petrol heating unit in a petrol-driven boat increases the fire hazard!



If local regulations permit the installation of petrol-driven heaters, then the following rules must be complied with:

- Do not install heater units where flammable vapours can form, i.e. in particular in engine compartments or tank compartments and rooms directly connected to them.
- Combustion air intake must come from the outside, and not from the engine compartment
- Do not route exhaust pipes through engine or tank compartments.
- Install the metering pump in the coolest possible location < 20 °C.

The above requirements also apply to the installation of diesel-driven heater units. In this case the heater unit must be supplied from a separate diesel tank, which must comply with the valid regulations for diesel tanks in boats.

7 Air ducting

7.1. Heating air intake

CAUTION!

The heating air intake must be carried out in a clean area without exhaust gases.

Never from the engine compartment!



- It must not be possible to block the intake opening with stowed articles (requirement from 2001/56/EC).
- Intake via an intake hose results in pressure loss. Take this into account in the resistance calculation.
- Use a grille or intake guard so that no foreign bodies can be drawn into the heater unit.

It is possible to use the heating air intake for fresh-air operation or recirculation:

7.1.1. Fresh air operation

Draw in heating air from the outside, heat and blow out into the interior areas. This renews the cabin air and reduces humidity. Ensure that there are enough ventilation openings in the cabins. An external temperature sensor must be mounted for temperature control, preferably in the saloon. In summer, ventilation is also possible (when the MC04 comfort heater control is used).

- Draw in heating air directly from lockers or rudder boxes if they are dry, clean and free of odours and exhaust gases. For proper ventilation, ensure an intake diameter of $\geq 1.5 \times$ hose diameter of the heater unit.
- Otherwise, use an intake hose for intake from the outside.



- Prevent water from entering through the intake opening.

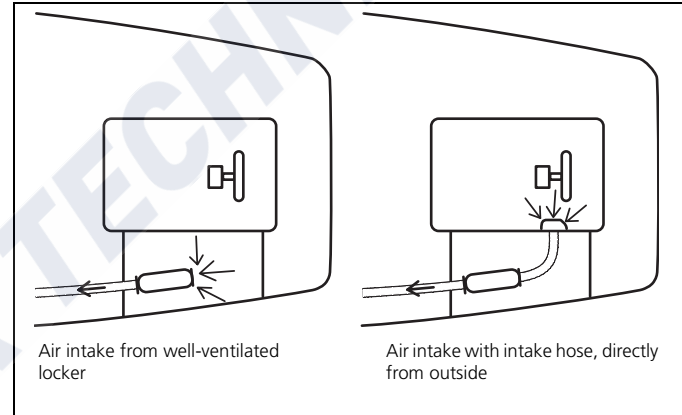


Fig. 22: Air intake

7.1.2. Circulation air

With recirculation, the air to be heated is taken from the interior area. The advantage to this is fast heating due to better heat utilisation. However, there is no reduction in the humidity or renewal of the room air. In this case, no external temperature sensor need be installed. The heater unit uses the sensor integrated in the control unit. For this purpose, the terminating resistor must be mounted on the control unit or the wiring harness.

Air ducting

7.2. Heating air ducting

7.2.1. Routing hoses

WARNING!

Fire danger! Use only temperature-resistant Webasto hot air hoses!



WARNING!

Do not drill into the outer skin of the ship! Danger of drowning!

Danger of injury or damage! Route hot air hoses away from contact and insulate them!



- Heating air ducting: avoid compressing or pinching the heating air hoses!

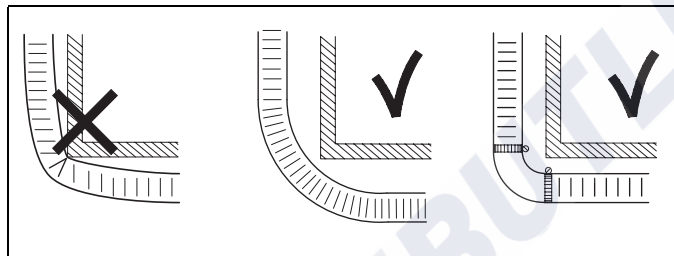


Fig. 23: Recommended hose routing around corners

- Do not route heating air hoses through bilge.
- Heating air hoses in damp areas: use temperature-resistant, flexible plastic hoses with metal spirals.



- In storage areas: protect the heating air hoses against damage by cargo, e.g. with a perforated metal cover.
- Recommendation: Routing through bulkheads: use wall ducts as shown in the illustration (protection against chafing). See the Webasto accessories catalogue.

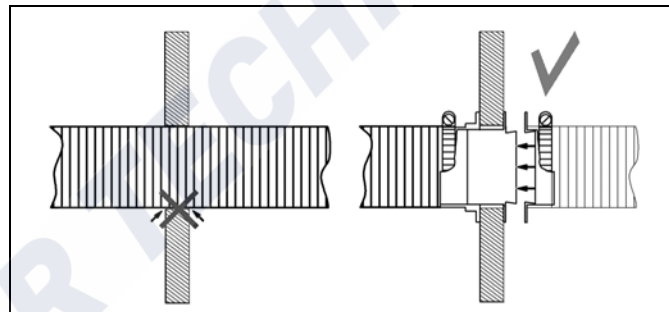


Fig. 24: Recommended hose duct through bulkheads with wall duct

- Secure the hoses: with hose clamps at all connecting elements.

- Recommendation for routing hoses through area not to be heated: fit the hose sections with hose insulation to prevent heat loss (Webasto Thermoduct available as an accessory).



Fig. 25: Webasto Thermoduct

7.2.2. Silencers in air ducting

Recommendation: For Air Top Evo 5500 units with short heating air ducting, use silencers on the intake and/or exhaust side (reduction in noise level)! See the accessories catalogue.

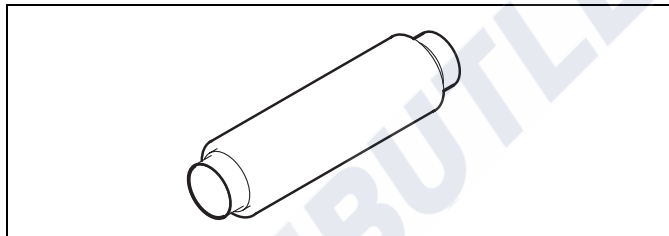


Fig. 26: Heating-air silencer for reducing noise level

7.2.3. Air distribution and outlets

All desired areas in the boat can be evenly heated with an appropriate air distribution. For this purpose, branch off several side branches from the main line to reach all cabins. The air, and therefore the heat flow, can be influenced by a suitable selection of branches and hose diameters. See the accessories catalogue for branches, connecting elements, Y-junctions, air outlets, etc. of temperature-resistant material.

WARNING!

Danger of injury! Do not blow hot air directly onto living creatures or temperature-sensitive objects!



- Hoses: keep as short as possible (heat loss).
- Hose routing: straight if possible (large bending radii).
- Recommendation: use distributors with butterfly valves and Bowden cable adjustment (desired regulation of the air flows).
- Use the same hose diameter in the main line from the heater unit to the main air outlet.
- It must not be possible to close off the air outlets from the main line to avoid overheating of the heater unit. Side branches: closeable air outlets are possible.
- Note: arrange the air outlets so that they cannot be blocked (requirement from 2001/56/EC).
- A free flow of air into the cabins enables the best cabin heating and air circulation.
- Only use one or two air outlets per cabin.
- Position of the air outlets: just above the floor (best air circulation).



- Select the air outlet colour to match the interior, see the accessories catalogue.



When using air distributors, the principle that air always takes the path of least resistance applies. The type and orientation of the distributors have exactly the same effect as the diameter and the flow resistance of the connected air hose.

Rough orientation for the distributor selection:

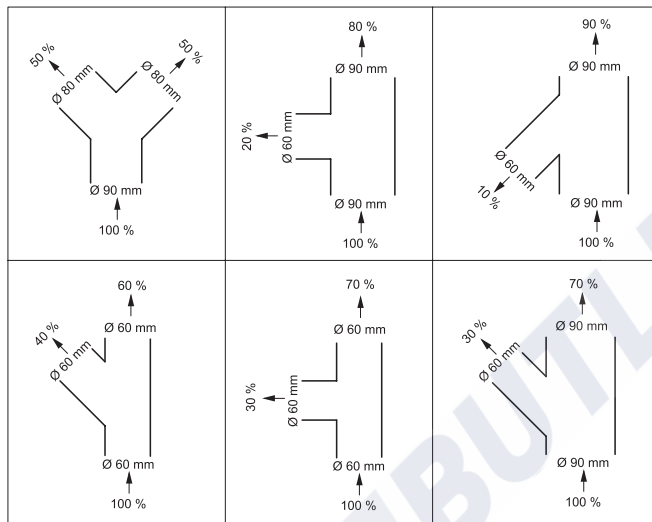


Fig. 27: Principle of air distribution with branches

7.2.4. Design using resistance points

Optimal heat output of an air heating system: air flows from the heater unit into the interior with as little restriction as possible. Air distribution on the intake and outlet sides presents flow resistance as follows. Keep this resistance as small as possible.



The heaters check the internal temperature rise automatically each time they are switched on. If this is above the defined limits, the start is cancelled and an error message is displayed.

As a reference value for the maximum permissible air ducting, air ducting components have so-called "resistance points" that represent a flow resistance value. The greater the resistance point of an air ducting component, the more poorly the air flows through it.

Table 1 lists common components and their resistance points.

For the complete range of parts: see Webasto accessories catalogue.

Before installing the air ducting system, make sure: the permissible total sum of the resistance points in the main branch are not exceeded (otherwise there is a risk of the heater unit overheating or premature reduction of the heating capacity while the interior has not yet been warmed up).



Air Top 2000 ST:	max. 325 points
Air Top Evo 3900:	max. 550 points
Air Top Evo 5500:	max. 375 points

Determine the resistance points of the planned air ducting: add together the individual resistance points of the components used in the main line. Main line begins at intake point E and ends at open air outlet A (see Figure 28).

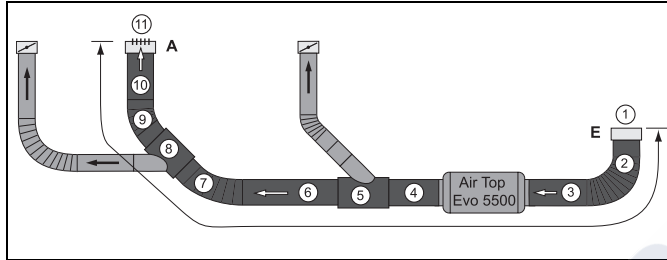


Fig. 28: Example of heating air ducting

Example: Air Top Evo 5500

No.	Component	Resistance Points
1	Intake grille, 90 mm dia.	65
2	1 m heating air hose, 90 mm dia. curved	25+6
3	0.5 m heating air hose, 90 mm dia. straight	0.5 x 25
4	0.4 m heating air hose, 90 mm dia. straight	0.4 x 25
5	Branch, 90/60/90	16
6	1 m heating air hose, 90 mm dia. straight	25
7	0.5 m heating air hose, 90 mm dia. curved	0.5 x 25 + 6
8	Branch, 90/60/90	16
9	0.4 m heating air hose, 90 mm dia. curved	0.4 x 25 + 6
10	1 m heating air hose, 90 mm dia. straight	25
11	Air outlet, 90 mm dia. with 90° slats	33
Total:		268 points

Total of 268 points is less than the upper limit of 375 points for Air Top Evo 5500: design has good flow-related properties.

Optimal air distribution:

- short hoses
- few bends
- no reduction of total diameter
- non-closeable air outlets in main line
- flow-optimised branches and distributors.



Table 1 Resistance points table for common air ducting parts


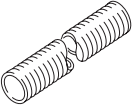
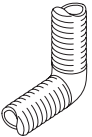

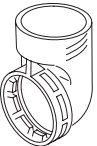
		55/60 mm inlet		80 mm inlet		90 mm inlet	
		[mm]	Points	[mm]	Points	[mm]	Points
	Intake grille	60	24	---		90	65
	Flexible pipe per meter	55 60	30 27	80	27	90	25
	Bend in flexible pipe	55 60	10 8	80	7	90	6
	Reduction	60 -> 55	27			90-->60 90-->80	211 45
	90° heating air elbow	60	90				

Table 1 Resistance points table for common air ducting parts

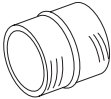





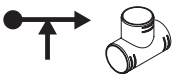











		55/60 mm inlet		80 mm inlet		90 mm inlet	
		[mm]	Points	[mm]	Points	[mm]	Points
	Hose connector	55 60	12 10	80	5	90	5
	90° elbow			80	50	90	77
	45° branch	60/60/60	9			90/60/90	8
	45° branch	60/60/60	21	80/80/80	50		
	Y-piece			80/55/55 80/60/60	230 201	90/80/80 90/90/90	50 42
	T-piece	60/60/60	13			90/90/90	13
	T-piece	60/60/60	63			90/90/90	61

Table 1 Resistance points table for common air ducting parts

		55/60 mm inlet		80 mm inlet		90 mm inlet	
		[mm]	Points	[mm]	Points	[mm]	Points
	 Distributor with butterfly valve	55/55/55 60/60/60	20 19	80/80/80	70	90/90/90	21
	 T-piece with thread	60/60/60	8			90/60/90	11
	 T-piece with thread	60/60/60	36			90/60/90	254
	Ball outlet	60	24	80	150		
	Closeable outlet	60	59			90	50
	Outlets	60 dia. 45°	139			90 dia. 45°	134
	Outlets	60 dia. 90°	35	80 dia. 90°	40	90 dia. 90°	33
	Wall connectors	60	10	80	12	90	12

7.2.5. Air ducting examples

A): Air Top 2000 ST Marine in 9 m sailboat:

B): Air Top Evo 3900 Marine in 11 m sailboat:

C): Air Top Evo 5500 Marine in 13 m sailboat:

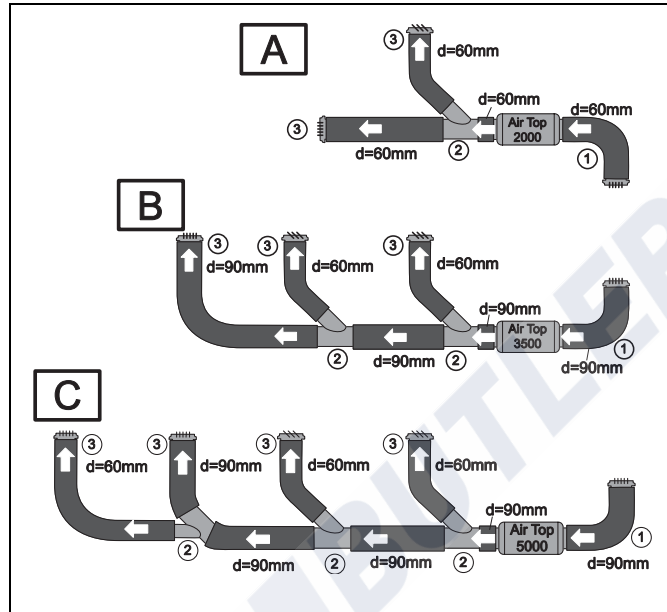




Fig. 29: Examples of heating air ducting

Legend for Figure 29:

-  open
-  open or closeable
- 1) heating air intake
- 2) Y-branch or T-piece
- 3) Air outlet

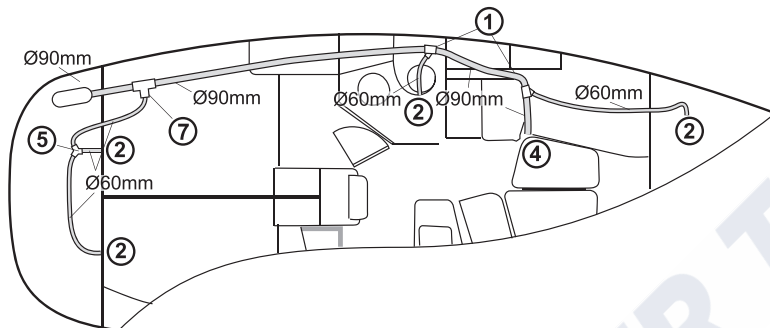
With the Air Top Evo 5500, no reduction of main line from 90 to 80 mm.

If continuous 90 mm is not possible, it is better to use a Y-piece 90/80/80 and produce two 80 mm main lines.

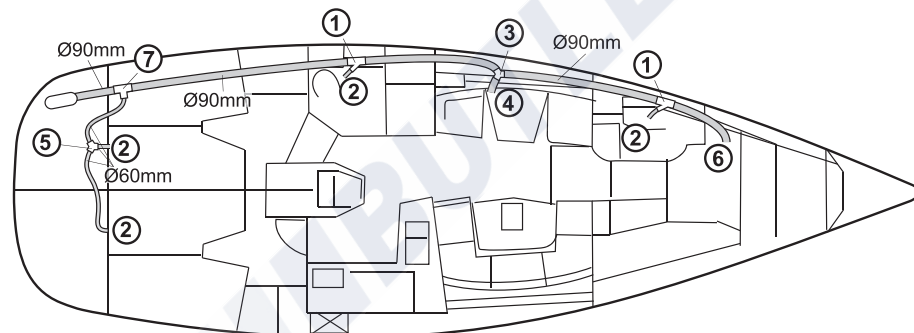


7.2.6. Installation examples

Air Top Evo 3900 Marine in 37' sailboat



Air Top Evo 5500 Marine in 43' sailboat



1. Branch, 90/60/90
2. Air outlet, 60 mm dia., closeable
3. Y-piece, 90/90/90;
4. Air outlet, 90 dia. open
5. Y-piece, 60/60/60
6. Air outlet, 90 mm dia., closeable
7. T-piece, 90/60/90

Fig. 30: Installation examples

8 Electrical connections

8.1. General electrical system

- Note: observe all information and safety precautions!
- Mount an operation indicator clearly visible for operators which indicates whether the heating is switched on or off (requirement from 2001/56/EC). This is integrated in the Webasto heater controls.
- Route all wiring harnesses and electrical components in dry, protected areas.
- All lines that are not required must be insulated at their free end.
- If highly sensitive electronic devices are on board: special electrical interference suppression may be necessary. Contact an authorised Webasto partner.
- Do not touch the open PCBs of the unit (electrostatic discharges).
- For the connector designations, see the legend and the wiring diagrams, Page 96 ff.

8.2. Wiring harnesses

Figure 31 and Figure 32 show the wiring harnesses for Air Top 2000 ST and Air Top Evo 3900/5500.

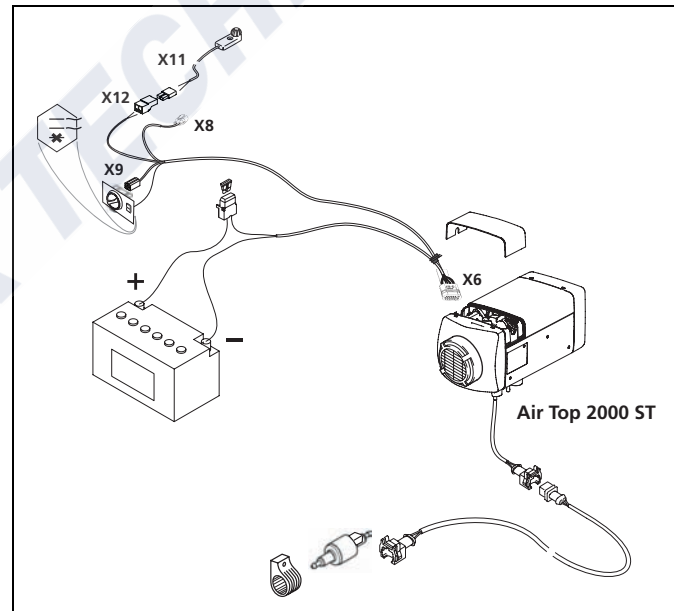


Fig. 31: Wiring harness of Air Top 2000 ST

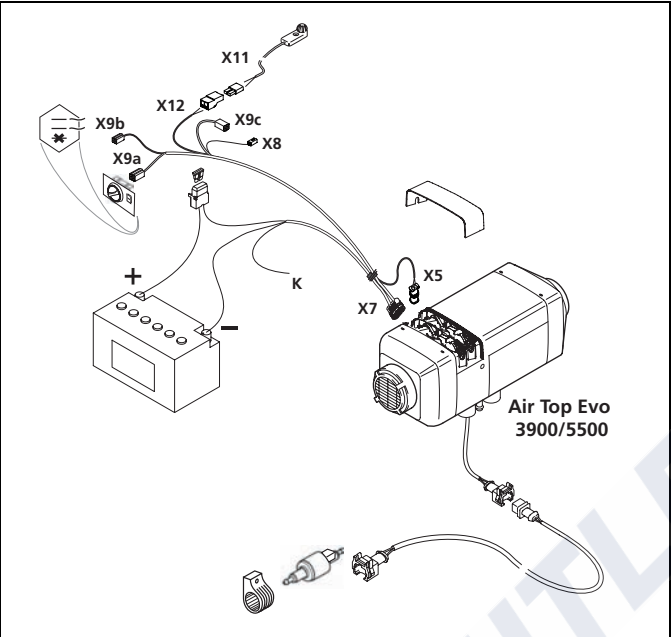


Fig. 32: Wiring harness of Air Top Evo 3900/5500

Connection of main wiring harness on heater unit

Lever open the cover of the heater unit (with a blunt object) as shown in Figure 33.

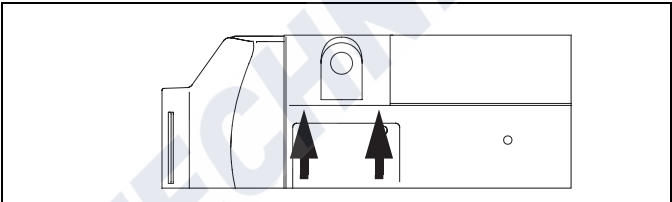


Fig. 33: Points for levering open control unit cover

Connect the wiring harness to the control unit of the heater unit (under grey cover). See Figure 34.

Press the plug until a "click" is heard (locking).

On the Air Top 2000 ST the plug must engage at point "a".

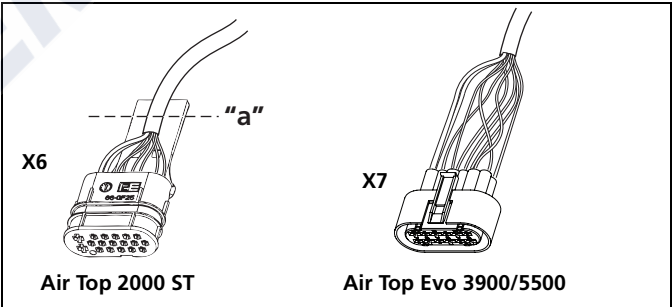


Fig. 34: Connector to control unit of heater unit

Air Top Evo 3900/5500:

Pull the black terminating resistor off the control unit and discard it. Connect the connector X5 of the wiring harness for the external temperature sensor to this socket.

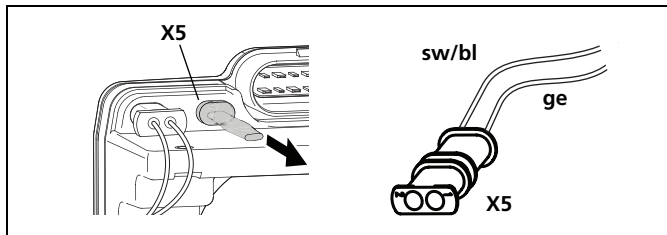


Fig. 35: Connecting external temperature sensor to control unit

To ensure that the cable passage in the control unit cover seals perfectly, the cable grommet is to be adjusted appropriately on the wiring harness.

Route the wiring harness out of the heater unit and mount the cover (possible in both directions).

The heater must not be operated without the control unit cover (this will cause the heater unit to overheat).

8.3. Power Supply

- Heating unit power supply: from the boat's service battery (not the starter battery for the driving engine due to the risk of discharging). Connect the red cable to the "+" terminal of the battery. Always make this connection before the main switch to ensure heating run-on.
Connect the brown cable to earth, directly on the battery.

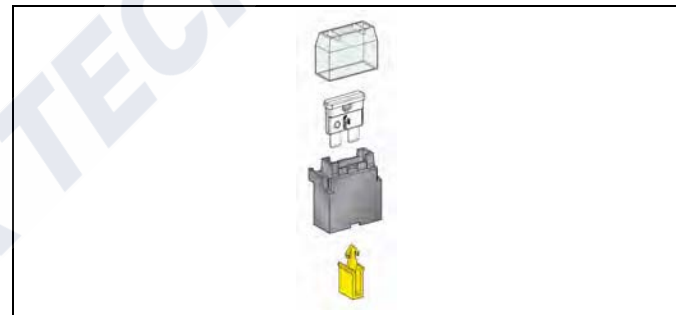


Fig. 36: Fuse holder in main wiring harness

- The wiring harness of the Air Top Evo 3900/5500 is equipped with cable K (Figure 32, colour rd/bk) for the optional control of a battery isolation switch or an additional operation indicator. If the cable is not necessary for this purpose, insulate the end of the cable.
- Power supply cables: keep them as short as possible. Shorten the cables if necessary.
- Connecting cable diameter: $\geq 4.0 \text{ mm}^2$.
If the cable lengths $> 7.5 \text{ m}$: $\geq 6.0 \text{ mm}^2$
- When extending cables, ensure an adequate total diameter and insulation type.

- The heater unit must be protected with a fuse (F1).
F = 20 A (12 V)
F = 15 A (24 V)
- If the MC04 heater control is used with the Air Top Evo 3900/5500, then a 1 A fuse (F3) must be inserted in the fuse holder.
- The fuse may only be installed splash-water protected in the interior.
- Distance of the main fuse from the positive battery terminal: ≤ 1 m

8.4. Temperature control

Install external temperature sensors in the boat's interior (mandatory for fresh air operation).

The heater unit continually compares the selected temperature (value set on the heater control) and the actual temperature (measured at the room temperature sensor) and automatically adjusts the heating capacity.

8.4.1. Installing external temperature sensor

Mount the sensor at a favourable/suitable location in the room to be heated.

The distance to the heater control ≤ 2.5 m due to the cable length. Use a 5 m long temperature sensor at greater distances, see the Webasto accessories catalogue.

Position: essential for control behaviour.

Recommendations:

- ✓ in largest cabin to be heated
- ✓ in position with average room temperature
- ✓ if possible at moderate height (half the room height)
- ✓ if possible on a vertical inner wall, and not directly on an outside wall
- not in the air flow of hot air outlets
- not within the range of the companion way
- not in the vicinity of heat sources
- not behind cushions or curtains
- not in direct sunlight



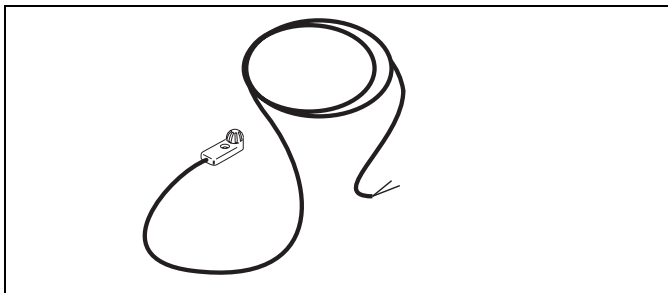


Fig. 37: Temperature sensor for detecting interior temperature

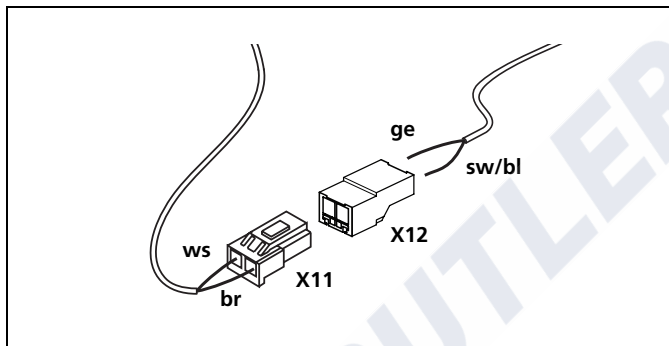


Fig. 38: Wiring of temperature sensor

Connection of external temperature sensor:

Route the cable of the external temperature sensor up to the installation location of the heater control. The sensor cable is connected to the main wiring harness there, see Figure 38.


- Insert the yellow and the black/blue cable into the transparent connector housing X12 provided. Any desired sequence can be used.
- Insert the cable of the external sensor into the transparent connector housing X11 provided. Connect in the mating connector on the main wiring harness.

8.5. Control element

This switches the heater unit ON/OFF and specifies the setpoint value for the interior temperature.

Position: mount easily accessible, visible and protected from water in the interior. The position has no effect on the control behaviour.

Various heater controls with different operating ranges are available, see the accessories catalogue.

Simply pull on the connector housing to unplug the connector. 

The connector housing can be locked (self-locking action) by simply pulling on the wiring harness.

8.5.1. Rotary switch

Connect the heater control (switching on/off and temperature preselection) directly to the wiring harness with the rotary potentiometer.

See Figure 39.

Air Top 2000 ST:

Connector X9: premounted connector for heater control.

Use the rt/ws cable for the ventilation switch (option). Install an earthing cable to the switch when using a ventilation switch.

Air Top Evo 3900/5500:

Connect connector X9a (rt, bl, ws, sw wires) with the blue marking on the connector to the heater control.

Connector X9b with the red marking on the connector is not required.

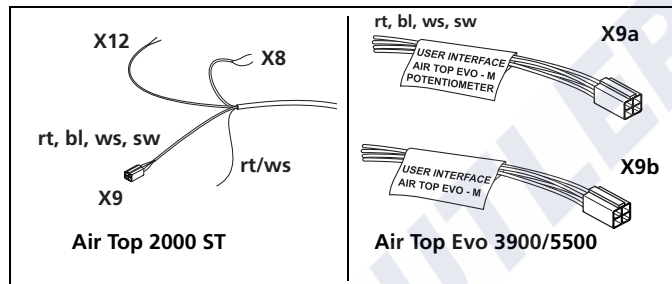


Fig. 39: Heater control wiring

The rotary knob should be installed as shown in figure 41.

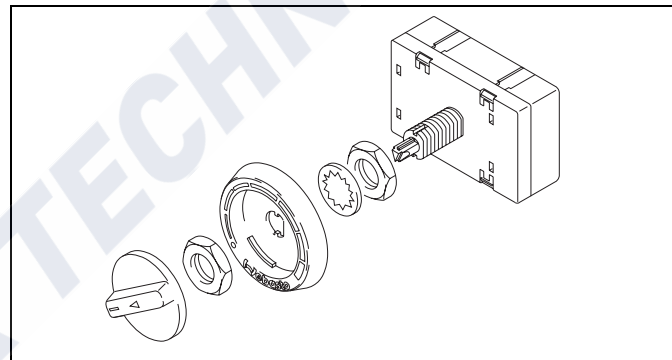


Fig. 40: Control element

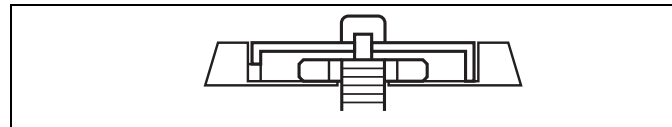


Fig. 41: Installation of the control element

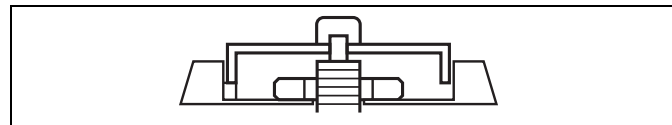


Fig. 42: Installation of the control element (incorrect)

8.5.2. Air Top EVO MC04 Marine heater control

The MC04 heater control is equipped with additional operating modes like ECO, PLUS and VENTILATION.

The MC04 can only be used in combination with Air Top Evo heater units.

- Produce a cut-out 98 mm wide x 63 mm high for the MC04.
- Connect the controls to the two existing connectors on the heater-unit wiring harness. When doing so, watch the sticker on the wiring harness and the colour coding on the connectors.

See Figure 39 (connector X9a and X9b), and Figure 43.

- Premount the heater control in the cut-out.
- Lightly press the fastening screws into the holes and screw in.
- Carefully clip on the trim frame.

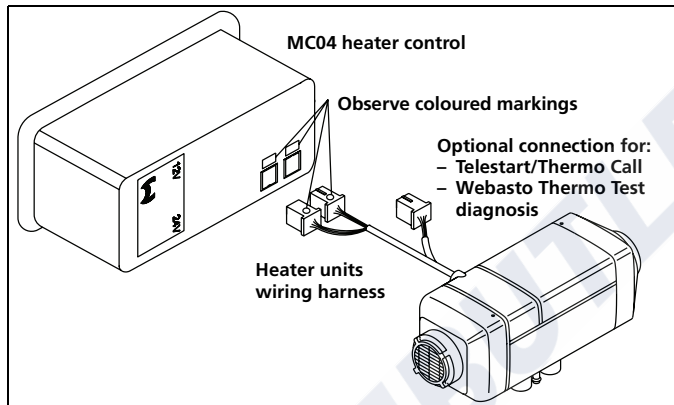


Fig. 43: Connection diagram for Air Top Evo 3900/5500 with MC04 heater control

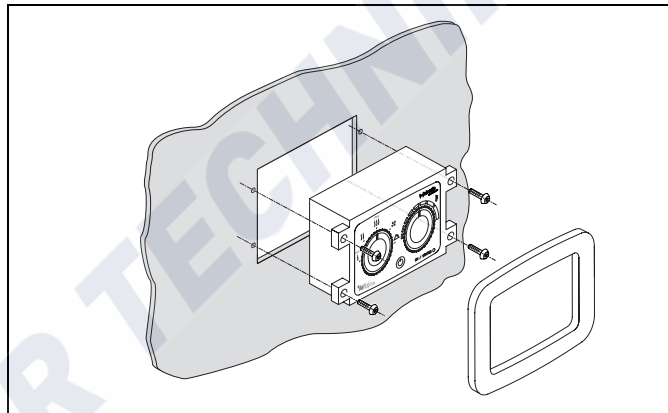


Fig. 44: Installing MC04 heater control

8.5.3. Combination timer

Use the combination-timer adapter wiring harness for installation and connect in accordance with the wiring diagram (Figure 48 and 50). Use the fuses F2 and, if necessary, also F4 for separate display lighting.

8.5.4. Telestart/Thermo Call

Air Top Evo 3900/5500:

Connector X9c (br, rt, gn/ws) can be connected to the optional Telestart remote control or the Thermo Call remote control.

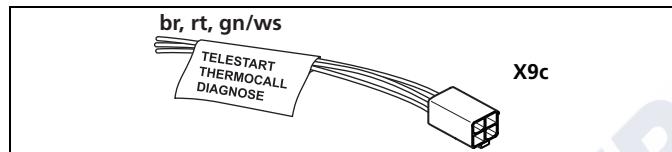


Fig. 45: Connector for Telestart/Thermo Call/Webasto Thermo Test

8.5.5. PC diagnosis

Air Top 2000 ST:

The wires (gn/ws, br/ws) enable any faults and the operating hours to be read out and a CO₂ calibration to be carried out with Webasto Thermo Test PC diagnosis (only for Webasto service workshops). Install the connector housing X8 (included).

Air Top Evo 3900/5500:

Connector X9c (see Figure 45) can also be used for Webasto Thermo Test PC diagnosis.

Also use connector X8 (wire colour br) for CO₂ calibration (only for Webasto service workshops).

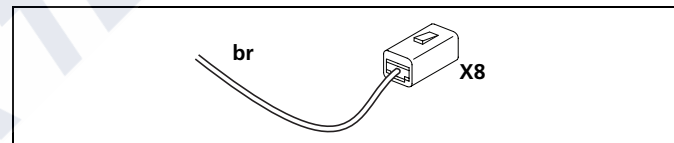


Fig. 46: CO₂ calibration connector

8.6. Metering pump

The wiring harness for the metering pump is normally routed out of the combustion-air intake connection piece. Pull out the stowed cable (and do not push it in again). Then connect it to the metering pump. The polarity is irrelevant. If the length is not sufficient, use an extension cable (accessory).

8.7. Wiring diagram

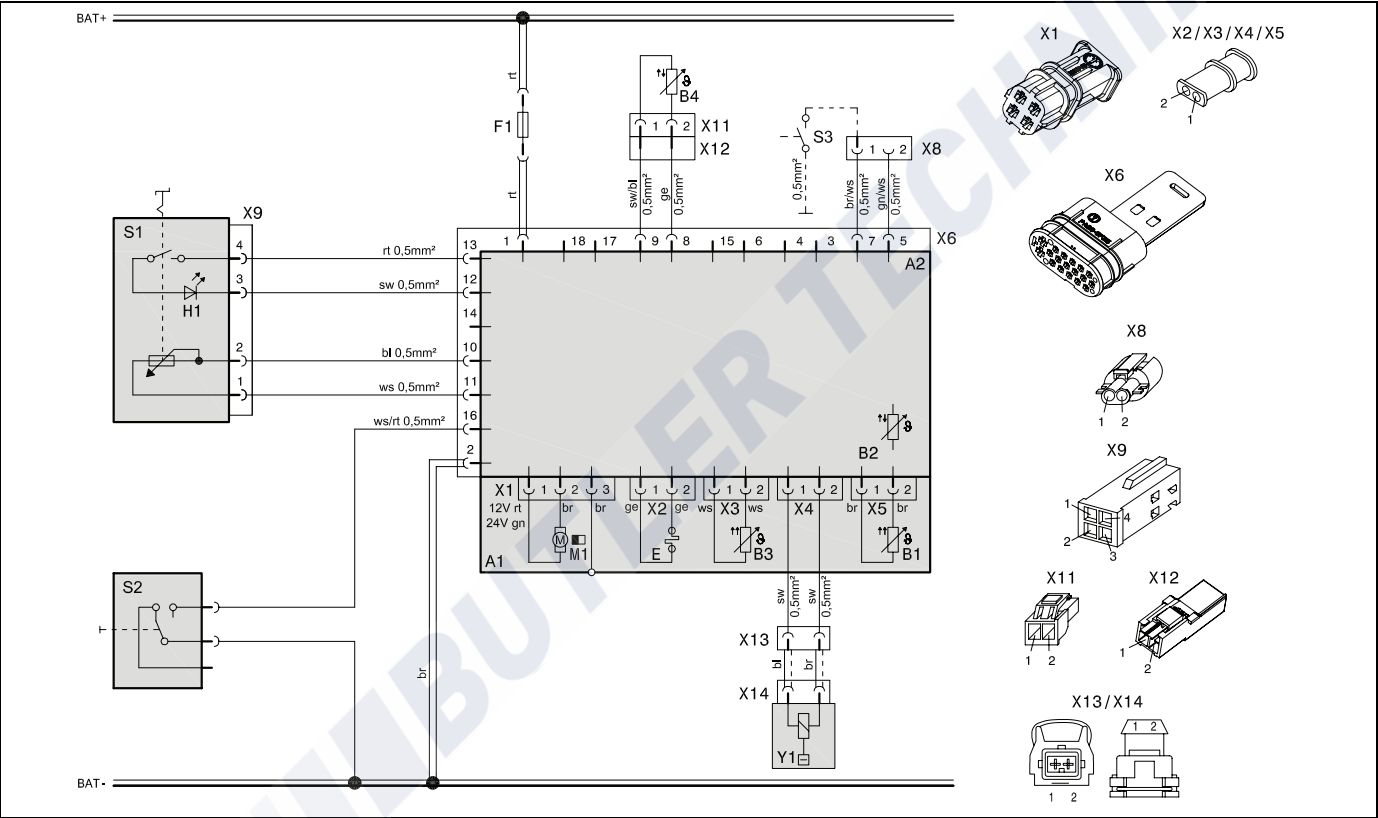


Fig. 47: System wiring diagram for Air Top 2000 ST, 12 V/24 V with rotary switch and ventilation switch (option), see page 101 and 102 for legend

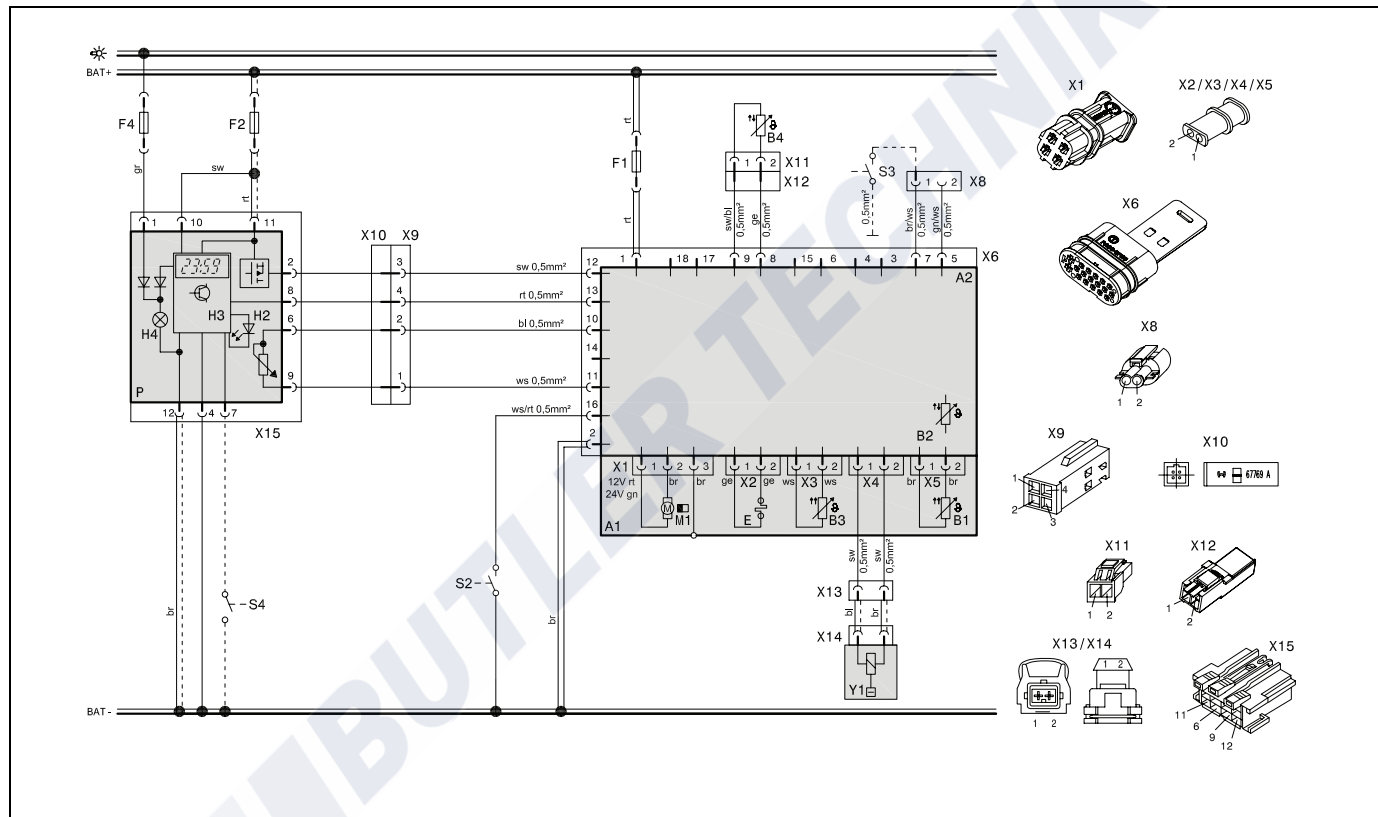


Fig. 48: System wiring diagram for Air Top 2000 ST, 12 V/24 V with combination timer, see Page 101 and 102 for legend

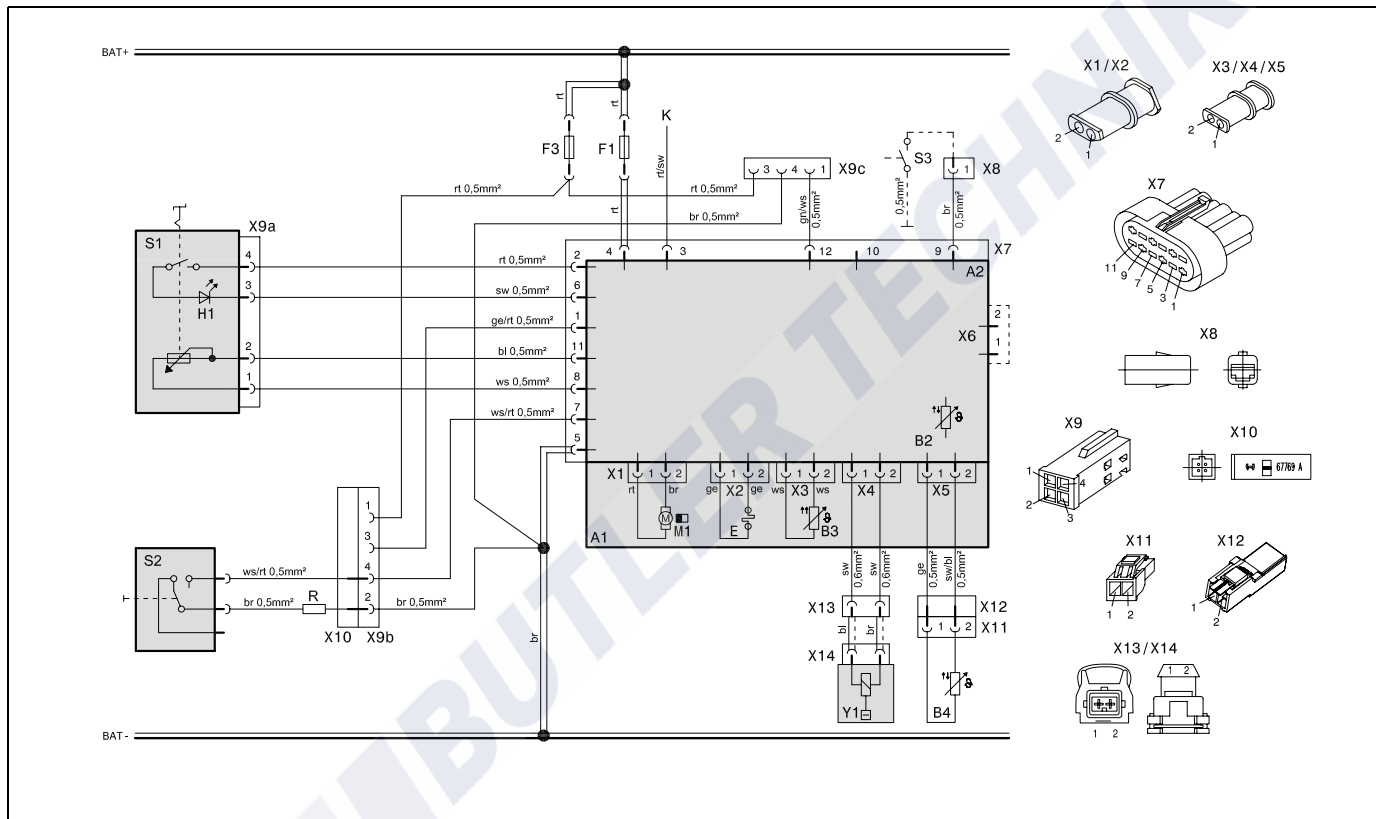


Fig. 49: System wiring diagram for Air Top Evo 3900 and Air Top Evo 5500, 12 V/24 V with rotary switch and ventilation switch (option), see Page 101 and 102 for legend

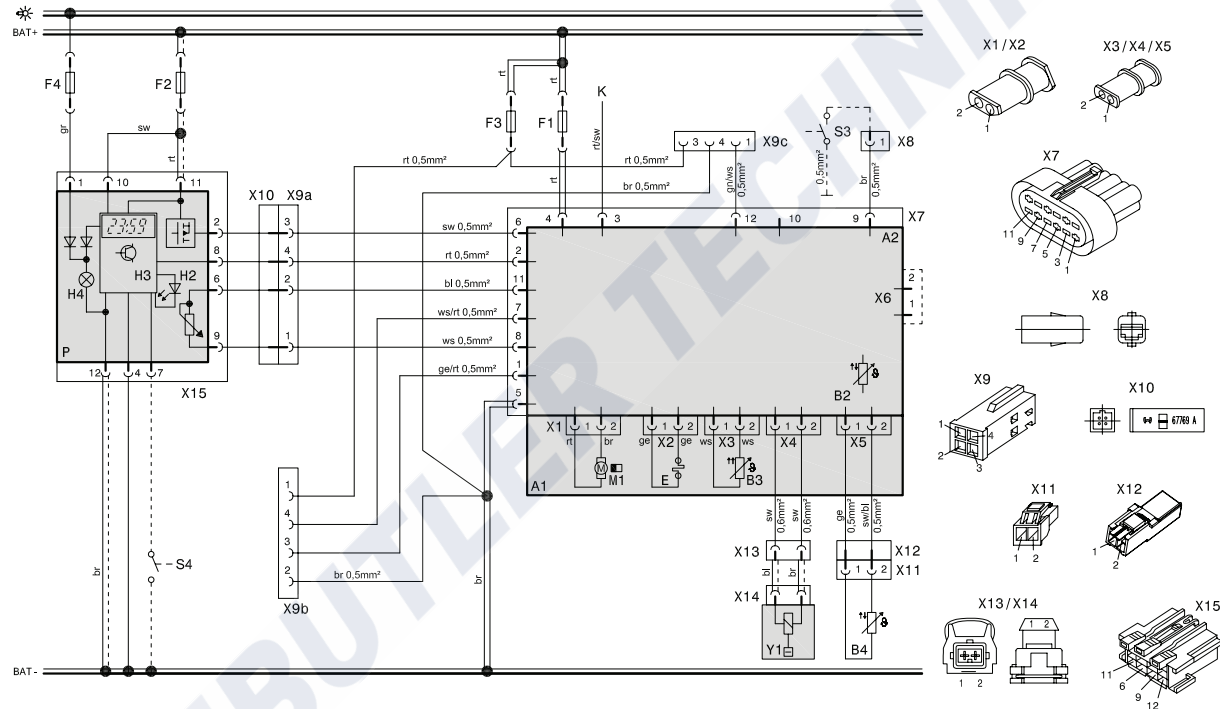


Fig. 50: System wiring diagram for Air Top Evo 3900 and Air Top Evo 5500, 12 V/24 V with combination timer, see page 101 and 102 for legend

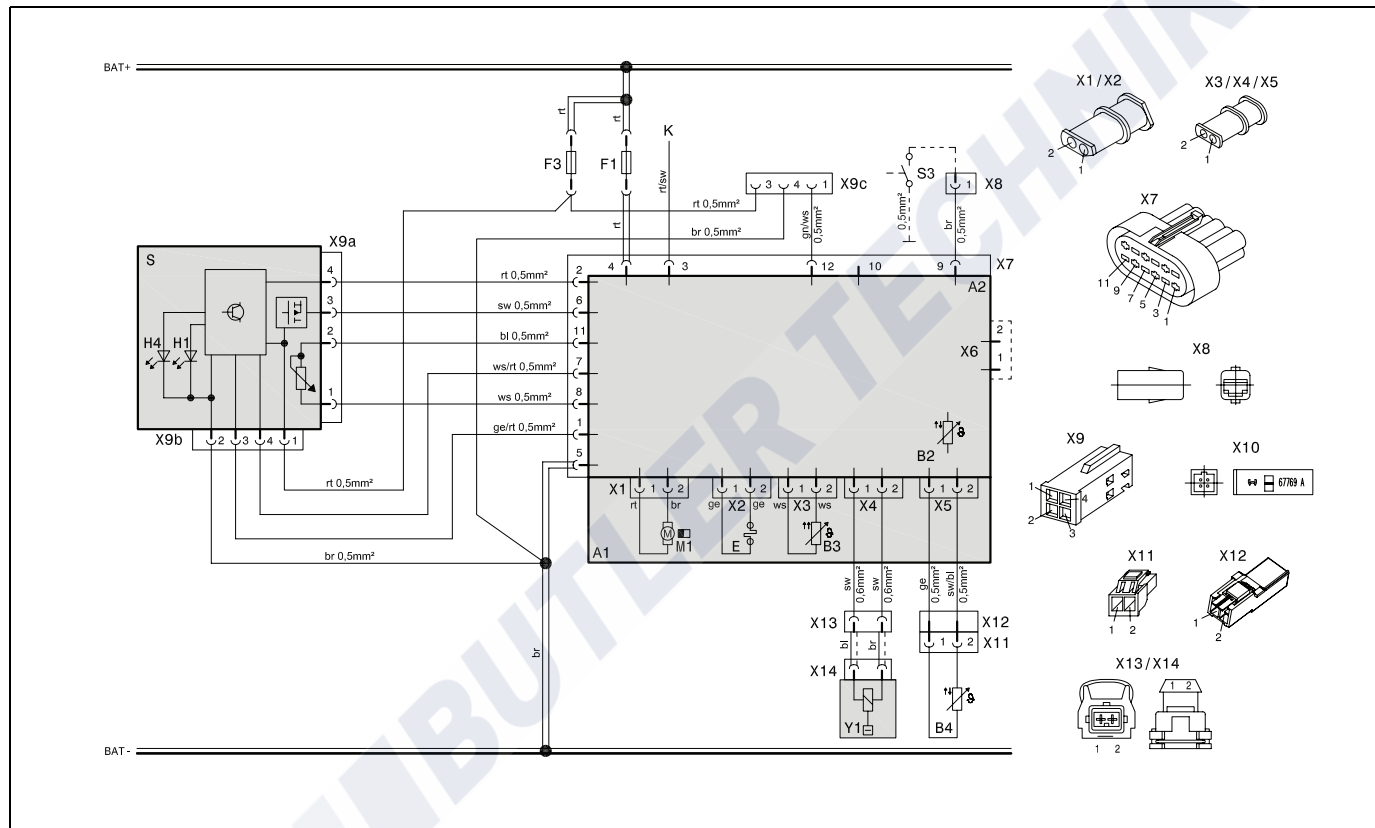







Fig. 51: System wiring diagram for Air Top Evo 3900 and Air Top Evo 5500, 12 V/24 V with MC04 heater control, see page 101 and 102 for legend

8.8. Legend for circuit diagrams

Cable cross-sections		
	< 7.5 m	7.5 - 15 m
	0.75 mm ²	1.0 mm ²
	1.0 mm ²	1.5 mm ²
	1.5 mm ²	2.5 mm ²
	2.5 mm ²	4.0 mm ²
	4.0 mm ²	6.0 mm ²

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

Item	Description	Comment
A1	Heater	Air Top 2000 ST/ Air Top Evo 3900/5500
A2	Control module	Control unit 1574 (for Air Top 2000 ST) Control unit 1580 (for Air Top Evo 3900/5500)
B1	Flame detector	Only on Air Top 2000 ST petrol units
B2	Temperature sensor	internal
B3	Overheating sensor	Overheating protection
B4	Temperature sensor	External
E	Glow plug/Flame detector	On Air Top 2000 ST glow plug only
F1	Fuse 24 V 15 A/12 V 20 A	Flat fuse SAE J 1284
F2	Fuse 4 A	Not contained in wiring harness
F3	Fuse 1 A	Flat fuse SAE J 1284
F4	Fuse 4 A	Not contained in wiring harness
H1	LED green (in Pos. S1)	Operation indicator
H2	LED red (in item P)	Light in immediate heat button, ready indicator, switch-on indicator
H3	Heating symbol in the display (in item P)	Operation indicator
H4	Lamps (in Pos. P and S)	Display and button lighting
K	Wire for maintaining voltage	Can be used optionally for additional operation indicator (< 6 W) or battery isolation switch
M1	Motor	Combustion and heating air fan
P	1531 combination digital timer	Timer and setpoint generator
R	Resistor	In adapter wiring harness

Item	Description	Comment
S	MC04 heater control	On button, selector switch for additional functions and setpoint generator
S1	Control element	On switch and setpoint generator
S2	Switch	Ventilation
S3	Switch	CO ₂ setting
S4	Push button	External immediate heat button
X1 - X7	Plug connection	At Pos. A2
X8 - X13	Plug connection	
X14	Plug connection	to item Y1
X15	Plug connection	to item P
Y1	Metering pump	

9 Approval and Commissioning

Before commissioning, the heater unit must be approved by an authorised Webasto partner!



- Only put a heater unit into operation when the system has been completely installed.
- Carefully bleed the fuel supply system. As a result of the low fuel consumption, the heater must be switched on several times to fill the fuel line.
- Test run of the heater unit: check all air and fuel connections for leaks and firm seating.
- If there are any fault messages during operation: conduct troubleshooting.
- Apply the type label/duplicate type label so that they are easy to read. Mark the year of initial operation. (Requirement from 2001/56/EC)



10 Operating Instructions

- Before switching on the unit, check whether the exhaust through hull for exhaust is clear.
- The unit must be switched off while refuelling.
- Do not operate in closed rooms, e.g. a shipyard - danger of suffocation.
- Set the adjustable hot air outlets so that they do not blow hot air directly onto living creatures or temperature-sensitive objects.
- The area around the heater unit must be kept clear. Do not store highly flammable or temperature-sensitive objects, such as plastic containers, oil cans, spray cans, gas cartridges, fire extinguishers, cleaning cloths, clothing, paper, sails, fenders, etc. on or next to the heater unit or allow them to come into contact during rough sailing!
- If fuel escapes: repair the damage immediately! Do not use the heater unit again until it has been repaired!
- If sea water enters the heater unit: do not start, but instead contact an authorised Webasto partner.
- Do not prematurely end heater unit run-on (e.g. by actuating the battery isolation switch), except for emergency shut-down. Emergency shut-down:
 - o Remove the fuse or
 - o Disconnect the heater unit from the battery (actuate the battery isolation switch).An emergency shut-down can damage the heater unit!
- Operate the heater unit roughly once a month (also in summer) for approx. 30 minutes to refresh the fuel in the line.
- Following installation (or acceptance by an authorised Webasto partner), return the guarantee card to Webasto! Keep the purchase receipt!
- Inform the insurance company of the installation (adjustment of the amount insured)!



11 Maintenance and Service

Heater units may only be repaired and maintained by an authorised Webasto partner.

Improper repairs can endanger life!

This is both for your own safety and for the safety of others. Regular maintenance of the heating system is required for trouble-free operation.

- Switch off the heater unit and allow all components to cool down before conducting repair work!
- Disconnect the battery before conducting repair work!
- Electrical welding: disconnect the positive battery terminal and connect to earth (control unit protection).
- Do not modify any components relevant to the heating system!
- Replacing fuses: only use fuses with the prescribed rating!
- Only use genuine accessories/genuine spare parts/parts from other manufacturers approved by Webasto!



DANGER



Every 2 years:

- Check exhaust values (CO, CO₂).
- Carry out PC diagnosis.

Every 10 years:

- Replace heat exchanger of air heater units 10 years after initial start-up! Enter installation date on plate provided. Affix plate on heater unit next to type plate.

Maintenance and service work is due at the following intervals:

Annually:

- Check electrical connectors and contacts for corrosion.
- Clean or replace fuel filter.
- Check fuel hoses for leaks.
- Check exhaust system for corrosion and leaks.
- Check combustion air intake, exhaust outlet, heating air intake and heating air outlets for unobstructed inlet and outlet.
- Check heating air hoses for damage.

12 Technical data

Except where limit values are specified, the technical data refer to the usual heater tolerances of $\pm 10\%$ at an ambient temperature of $+20\text{ }^{\circ}\text{C}$ and at the rated voltage and in rated conditions.

12.1. Electrical components:

Control unit, motor, metering pump, lamp in the timer and glow plug / flame monitor are designed for either 12 V or 24 V.

The timer, overheating sensor and temperature sensor component are not dependent on voltage.

12.2. Fuel

Diesel fuel according to the standard DIN EN 590 is suitable for use as fuel for the diesel-driven heater units.

When changing to low-temperature fuel, the heater unit must be operated for approx. 15 minutes so that the fuel line and the fuel pump are filled with new fuel.

The heaters are also licensed for use with PME (bio-diesel), which complies with DIN EN 14214 .

Heater	Operation	Air Top 2000 ST D
Type test permit	EMC: Heater unit:	e1*72/245*2009/19*1085 e1*2001/56*2006/119*0022 E1 00 0216
Model		Air heater with evaporator burner
Heat output	Control range	0.9 - 2.0 kW
Fuel		Diesel DIN EN 590 PME DIN EN 14214
Fuel consumption	Control range	0.1 .. 0.21 kg/h (0.12 .. 0.24 l/h)
Rated voltage		12/24 V
Operating voltage range		10.5 - 16 / 21 - 32 V
Rated power consumption	Control range	14 - 29 W
Max. ambient temperature: Heater: - Operation - Storage Metering pump: - Operation - Storage Heater control: - Operation - Storage		-40... + 40 °C -40... + 85 °C -40... + 20 °C -40... + 85 °C -40... + 75 °C -40... + 85 °C
Maximum combustion air inlet temperature		-40... + 20 °C
Adjustment range for interior temperature	Control range	+5... + 35 °C
Delivery rate for heating air at fan speed	against 0.5 bar	max. 93 m ³ /h at 4,750 rpm
CO ₂ in exhaust gas (permitted function range)	1 kW 2 kW	5.0 ... 8.0 9.0 ... 12.5
Heater dimensions		Length 311 ± 2 mm Width 120 ± 1 mm Height 121 ± 1 mm
Weight		2.6 kg

Heater	Operation	Air Top Evo 3900 Marine D		Air Top Evo 5500 Marine D	
Type test permit		e1*72/245*2006/96*5529 (Air Top Evo 3900 / 5500) E1 03 5529 (Air Top Evo 3900 / 5500) e1*2001/56*2006/119*0255 (Air Top Evo 3900) E1 00 0255 (Air Top Evo 3900) e1*2001/56*2006/119*0256 (Air Top Evo 5500) E1 00 0256 (Air Top Evo 5500)			
Model		Air heater with evaporator burner			
Heat flow: - Normal (Plus)	Control range	1.5 - 3.5 (3.9) kW		1.5 - 5.0 (5.5) kW	
Fuel		Diesel EN 590 PME DIN EN 14214			
Fuel consumption	Control range	0.17 - 0.42 (0.47) l/h		0.17 - 0.60 (0.66) l/h	
Rated voltage		12 V	24 V	12 V	24 V
Operating voltage range		10.5 - 16 V	21 -32 V	10.5 - 16 V	21 -32 V
Rated power consumption	Control range	15 - 40 (50) W		15 - 95 (116) W	
Max. ambient temperature:					
Heater:					
- Operation		-40... + 40 °C			
- Storage		-40... + 85 °C			
Metering pump - Operation		-40... + 20 °C			
- Storage		-40... + 85 °C			
Control element - Operation		-40... + 75 °C			
- Storage		-40... + 85 °C			
Maximum combustion air inlet temperature		-40... + 20 °C			
Adjustment range for interior temperature		+5... + 35 °C			
Delivery rate of heating air	against 0.5 bar	max. 140 (155) m³/h		max. 200 (220) m³/h	
CO ₂ in exhaust gas (permitted function 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 %	
Heater dimensions		Length 423 ± 2 mm Width 148 ± 1 mm Height 162 ± 1 mm			
Weight		5.9 kg			

Im Fall einer mehrsprachigen Version ist Deutsch verbindlich.
In multilingual versions the German language is binding.
Bij een meertalige versie is de Duitse versie bindend.

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