Air Top Evo 40 and Air Top Evo 55

Comparison to Air Top Evo 3900 und Air Top Evo 5500
Differences Air Top 3900/5500 to Air Top Evo 40/55
## Overview

### Improvement in quality and function

<table>
<thead>
<tr>
<th>Changes Air Top Evo 40/55 vs. Air Top Evo 3900/5500</th>
<th>Benefit and Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>New flame detection by exhaust gas temperature sensor</td>
<td>✓ Patented solution evaluation</td>
</tr>
<tr>
<td></td>
<td>✓ High accuracy leads to a stable system</td>
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<td></td>
<td>✓ Improvement in life expectancy</td>
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<td>✓ “Long-lasting-heating”, (long time in the same heating level)</td>
</tr>
<tr>
<td>Increased heating power: 4 kW instead of 3.9 kW</td>
<td>✓ Better argument against the competitor D4</td>
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<td></td>
<td>✓ Boost time for EVO 40 extended to 6 hours</td>
</tr>
<tr>
<td>Change of fuel pump control (modulated PWM-signal)</td>
<td>✓ Noise reduction</td>
</tr>
<tr>
<td>Intelligent blower control</td>
<td>✓ <strong>Reduction of electric power consumption</strong></td>
</tr>
<tr>
<td></td>
<td>✓ Noise reduction</td>
</tr>
<tr>
<td></td>
<td>✓ <strong>Higher back pressure resistance</strong></td>
</tr>
<tr>
<td>Improved starting logic</td>
<td>✓ Faster start with cold heater</td>
</tr>
<tr>
<td>Intelligent low voltage cut-out</td>
<td>✓ Low voltage cut-out has now been lowered to 9,5V during glowing period. In normal operation it stays at 10,5V to save the battery.</td>
</tr>
<tr>
<td>Intelligent altitude adjustment</td>
<td>✓ Intelligent altitude adjustment (compensation starts only above 600m above sea level → reduced electrical power consumption</td>
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</tbody>
</table>
Overview Air Top Evo 40 / 55
Changed components compared to Air Top Evo 3900/5500

1. ECU
2. Fan
3. Burner Flange
4. Exhaust temperature sensor (ATS)
5. ATS Spring Clamp
6. Holding plate
7. Heat exchanger
8. Restrict
Comparison of components
Innovative Flame Detection Concept

Glow Plug Functions
- Ignition of the fuel / air mixture
- Flame recognition due to heat input

Glow Plug Function
- Ignition of the fuel / air mixture

Exhaust Temperature Sensor Function
- Flame detection via exhaust gas temperature
Comparison of components
Electronic Control Unit - ECU

**Air Top Evo 3900/5500**
- Control unit in 3 parts, inclusive aluminum cooling element
- Obsolescence of components – processors not available anymore

**Air Top Evo 40/55**
- ECU in 2 parts, better and lighter material
- Better sealing against humidity - IP protection class IP5K3
- EMC improvement
- Lead free solder
- No backwards compatibility to Air Top Evo 3900/5500
Comparison of components
Electronic Control Unit - ECU

Air Top Evo 3900/5500

- X1 = Connector Burner & Air Heater Fan
- X2 = Connector Glow Plug
- X3 = Connector Overheat Sensor
- X4 = Connector Fuel Pump
- X5 = Connector External Temperature Sensor (resistor if there is no sensor)
- X6 = Connector D+ and Secondary Drive
- X7 = Connector Air Heater Cable Harness

Air Top Evo 40/55

- Blank plug by missing of external temperature sensor
- X1 = Connector Burner & Air Heater Fan
- X2 = Connector Glow Plug
- X3 = Connector Overheat Sensor
- X4 = Connector Fuel Pump
- X5 = Connector External Temperature Sensor
- X6 = Connector D+ and Secondary/Auxiliary Drive
- X7 = Connector Air Heater Cable Harness
- X8 = Connector Exhaust Air Temperature Sensor
Comparison of components
Modified Components

- Additional hole for Exhaust Temperature Sensor cable routing

- Exhause Air Temperature Sensor
  - exhaust air temperature sensor
  - Flame detection sensor

- ATS Spring Clamp
  - Fixation of Exhaust Air Temperature Sensor

- Holding Plate ATS Cable
  - Fixation of Exhaust Air Temperature Sensor cable

- Burner Flange
  - Additional hole for Exhaust Temperature Sensor cable routing

- Fan
  - Small adaption on bottom surface to avoid scratching on ECU
  - Backwards compatible
Comparison of functionality
DP 42: new activation logic of fuel pump

**With Air Top EVO 40/55 not only DP42 is standard but also fuel pump activation has improved:**

- Intelligent multistage control:
  - a) Short impulse of full voltage to get piston going
  - b) reduction of voltage to move piston slowly. Piston will softly touch the end stop at slow speed → reduced ticking noise!
  - c) Voltage is increasing to full level. In case of high pressure situation piston is now moving the very last bit until the end stop.
Comparison of functionality
Intelligent blower control

Air Top Evo 3900/5500
linear Air Blower- Characteristic Control Line

- Step less regulation, fixed blower speed depending on heat output

Air Top Evo 40/55
Intelligent blower control logic

- Lower electrical power consumption for applications with low to medium back pressure (lower motor speed at same output power)
- Lower noise at regular operation due to lower motor speed
- Improved back pressure resistance for applications with high back pressure level. Motor speed will increase keeping heat output constant.
  \[ \Rightarrow \] Higher availability of the heating power. Heater will reduce output much later than before
Comparison of functionality
Intelligent blower control

Electrical power consumption at 0mbar back pressure
= free blowing

With a free-blowing heater the blower speed reduction for the new AT EVO 40/55 is the highest. The savings in electrical power consumption are in between -16% and -22%.
Comparison of functionality
Intelligent blower control

Electrical power consumption at 0,5mbar back pressure

= very good application

With a very good application creating 0,5mbar of back pressure the blower speed reduction is still substantial. The savings in electrical power consumption are in between -11% and -21%.
Comparison of functionality
Intelligent blower control

Electrical power consumption at 1,0 mbar back pressure

= good Marine application

With a typically good application creating 1,0 mbar of back pressure the blower speed reduction is still substantial. The savings in electrical power consumption are in between -10% and -20%
Absolute more tricky case is when restrictions in flow are present but limited, allowing the heater to start but not running in full operation mode.

In the a.m. case the overheating sensor is “managing the heater” by reducing power avoiding serious troubles to the heater an piping system.

This operating function is instructed to deal with current norms and temporary restriction flow at the outlets.

This particular operation mode is feasible to be detected with the use of the Webasto diagnose only, making very difficult to perceive it.

The heater is operating but is not heating enough..

That is the customer claim you may get, with no error messages 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 is the resistance point of an air ducting component, more poorly the air flows through it.

• Before installing the air ducting system, make sure that the allowed total sum of the resistance points in the main branch is not exceeded (otherwise there is the 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.
Comparison of functionality
Intelligent blower control

Electrical power consumption at 1,5 mbar back pressure
= poor marine application or some outlets closed

With a poor RV application creating 1,5 mbar of back pressure the blower speed reduction is only existing at lower heat outputs. At highest heat output the consumption goes slightly up. The AT EVO 3900 already reduces the max. heat output.

The Air Top EVO 40 manages to deliver its max. heat output by increasing rpm’s.

At 1,5 mbar the Air Top EVO 3900 already reduces its max. heat output.

<table>
<thead>
<tr>
<th>Heizleistung in W</th>
<th>AT Evo 40 P_el [W]</th>
<th>AT Evo 3900 P_el [W]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1500</td>
<td>-24%</td>
<td>-21%</td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2500</td>
<td>-21%</td>
<td>+6%</td>
</tr>
<tr>
<td>3000</td>
<td></td>
<td></td>
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<tr>
<td>3500</td>
<td></td>
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<tr>
<td>4000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5000</td>
<td></td>
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</tbody>
</table>
Comparison of functionality
Intelligent blower control

Electrical power consumption at 2,0 mbar back pressure
= bad marine application or many outlets closed

With a bad RV application creating 2,0 mbar of back pressure there is no electrical saving any more but instead an increase in heat output availability. Thus, customers will still be able to heat up their vehicle even in these tough conditions.

The Air Top EVO 40 only slightly has to reduce its max. heat output and still delivers 3,9 kW

At 2,0 mbar the Air Top EVO 3900 delivers not more than 2,5 kW of heat
Comparison of functionality
Intelligent altitude adjustment

Air Top Evo 3900/5500
Standard Altitude adjustment

- Pressure sensor was integrated in selected number of heater variants
- Compensation of thinner air achieved by increasing rpm’s of combustion blower motor. This compensation was starting just above sea level going up to 2200m altitude
- This resulted in increased electrical power consumption right above sea level.

Air Top Evo 40/55
Intelligent altitude adjustment

- Pressure sensor integrated in all heaters now
- Compensation of thinner air is also achieved by increasing rpm’s but it now starts only above 600m altitude. Below this level there is no compensation and thus no increased electrical power demand.
  - reduced electrical power consumption particularly at altitude levels below 600m
Comparison of functionality
Start Guarantee – Undervoltage threshold

**Air Top Evo 3900/5500**
Constant undervoltage threshold

- Undervoltage threshold is independent from operating mode
- Undervoltage failure detected if voltage falls below threshold for > 20 sec.
  - 24 V heater = 20,5 V; 12 V heater = 10,5 V
- Overvoltage failure if threshold is higher for > 6 sec.
  - 24 V heater = 31,0 V; 12 V heater = 16,0 V
- In Marine’s a “half full” battery sometimes could not start the heater any more (low voltage failure) → customer complaint!

**Air Top Evo 40/55**
Lower undervoltage during glow phases

- Undervoltage depends on operating status
- During glow phase amperage is quite high and a voltage loss occurs in supply cables. Measured voltage at control unit is reduced
  - During glow phase a second lower voltage threshold at 9,5V (19,5V for 24V heaters) is applied → heater is able to start with “half full” battery. Failure trigger time >6 sec.
- If heater is not glowing the “normal” threshold applies like before in order to protect battery. Failure trigger time > 20 sec.
Comparison of functionality
Extended heating performance, Autoboost

**Air Top Evo 3900/5500**
Manually extended heating „Plus“

- Manual activation of the extended heating "Plus" only by operating panel model MC04/05
- Duration: until the desired room temperature is reached or time limit:
  - 60 minutes at Air Top Evo 3900
  - 30 minutes at Air Top Evo 5500

**Air Top Evo 40/55**
Cold start automatic, manually extended heating „plus“, Autoboost

- **Cold start automatic: heater always starts in boost mode for quick heating of the cabin also with simple knob user interface**
  - Duration: until the desired room temperature is reached or time limit:
    - 6 hours at the Air Top Evo 40
    - 30 minutes at the Air Top Evo 55
  - ECO mode still possible with operating panel MC04
Summary
New Heater Air Top Evo 40/55
Key facts

- **More Comfort**
  - More silent operation mode (intelligent blower control reduces air flow if possible & half-stroke pump DP42)
  - Auto boost during cold start to 4000/5500 W
  - Quicker start of the heater ⇒ Very rapid availability of warm air
  - Intelligent altitude adjustment for operation up to 2200m a.s.l.

- **More Efficiency**
  - Robust and powerful with 1,5 to 4 kW / 5,5 kW
  - Boost time of the EVO 40 has been increased from 30 min to 6 hrs. This will help us in reaching heat up targets of EN 1646
  - High product quality with high life time (4000 operating hours)
  - Lower electrical energy consumption: up to 30% energy saving due to intelligent blower speed control and intelligent altitude adjustment compared to Air Top EVO 3900

- **More safety and reliability**
  - Exhaust air temperature sensor for flame detection
  - New low voltage protections ensures a longer usage of the battery capacity
Benchmark with Eberspächer Airtronic D4
### Benchmark Eberspächer Airtronic D4

#### Overview results, 24V

<table>
<thead>
<tr>
<th></th>
<th><strong>Airtronic D4</strong></th>
<th><strong>Air Top Evo 40</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size &amp; weight</strong></td>
<td>(Length x width x height): 371 x 140 x 150 [mm]</td>
<td>(Length x width x height): 423 x 148 x 162 [mm]</td>
</tr>
<tr>
<td></td>
<td>(Weight): 4.7 [kg]</td>
<td>(Weight): 5.9 [kg]</td>
</tr>
<tr>
<td><strong>Heating power control behaviour</strong></td>
<td>In 4 steps</td>
<td>Without steps, sliding output control with intelligent automatic function for low power consumption</td>
</tr>
<tr>
<td><strong>Heating power control range</strong></td>
<td>In the range from 0.9 – 3.9 kW</td>
<td>In the range from 1.5 to 4 kW</td>
</tr>
<tr>
<td><strong>Heating at high altitudes</strong></td>
<td>Height adjustment over 1500m only with additional air pressure sensor possible</td>
<td>Height adjustment up to 2200m automatically ensured with integrated air pressure sensor</td>
</tr>
<tr>
<td><strong>Variability of mounting positions</strong></td>
<td>Horizontal, tilted forward 30°, rotated 90° to the right</td>
<td>Horizontal, tilted forward 90°(vertical installation), rotated 90 ° to the right and left</td>
</tr>
<tr>
<td></td>
<td>No vertical installation possible</td>
<td></td>
</tr>
<tr>
<td><strong>Heating flame detection / monitoring</strong></td>
<td>Flame detection by combined sensor (flame sensor/overheating sensor)</td>
<td>Flame detection by exhaust gas temperature sensor. Stable operation and improved continuous heating behavior</td>
</tr>
<tr>
<td><strong>Compliance with legal requirements</strong></td>
<td>Short-term exceeding of the outlet temperature of 150°C.</td>
<td>Limits according to Directive 2001/56/EC are met.</td>
</tr>
</tbody>
</table>