## ENGINE COOLING SYSTEM

### INDEX

<table>
<thead>
<tr>
<th>Component</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGINE COOLING SYSTEM</td>
<td>07-3</td>
</tr>
<tr>
<td>- Description</td>
<td>07-4</td>
</tr>
<tr>
<td>- Operation of the circuit</td>
<td>07-4</td>
</tr>
<tr>
<td>- Checking the level and changing the engine coolant fluid</td>
<td>07-4</td>
</tr>
<tr>
<td>- Expansion tank</td>
<td>07-5</td>
</tr>
<tr>
<td>- Removal/Refitting</td>
<td>07-5</td>
</tr>
<tr>
<td>- Pressurized cap sealing test</td>
<td>07-6</td>
</tr>
<tr>
<td>- Hydraulic system proof test</td>
<td>07-6</td>
</tr>
<tr>
<td>- Water pump</td>
<td>07-6</td>
</tr>
<tr>
<td>- Removal/Refitting</td>
<td>07-7</td>
</tr>
<tr>
<td>- Thermostat unit</td>
<td>07-9</td>
</tr>
<tr>
<td>- Removal/Refitting</td>
<td>07-9</td>
</tr>
<tr>
<td>- Radiator</td>
<td>07-10</td>
</tr>
<tr>
<td>- Removal/Refitting</td>
<td>07-10</td>
</tr>
<tr>
<td>- Dis-assembly</td>
<td>07-12</td>
</tr>
<tr>
<td>- Cooling fan</td>
<td>07-13</td>
</tr>
<tr>
<td>- Removal/Refitting</td>
<td>07-13</td>
</tr>
<tr>
<td>- Dis-assembly</td>
<td>07-13</td>
</tr>
<tr>
<td>- Fan control thermal contact (Specific for 95 versions)</td>
<td>07-14</td>
</tr>
<tr>
<td>- Removing/Refitting</td>
<td>07-14</td>
</tr>
<tr>
<td>- Checks and inspections</td>
<td>07-14</td>
</tr>
<tr>
<td>- Coolant temperature gauge transmitter and maximum temperature warning light contact</td>
<td>07-14</td>
</tr>
<tr>
<td>- Removing/Refitting</td>
<td>07-14</td>
</tr>
<tr>
<td>- Checks and inspections</td>
<td>07-14</td>
</tr>
</tbody>
</table>

### TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

- Cooling system | 07-15
- Thermostat | 07-15
- Cooling fan thermal contact (Specific for 95 versions) | 07-15
- Coolant temperature gauge transmitter and max. temperature warning light contact | 07-15
- Tightening torques | 07-15
ILLUSTRATED INDEX

1. Water pump
2. Thermostatic cup
3. Cooling fans
4. Radiator
5. Fan control thermal contact
6. Coolant temperature gauge sender and maximum temperature warning light contact
7. Expansion tank
8. Throttle body
9. Coolant temperature sensor (NTC)
10. Coolant temperature sensor (NTC)
11. Longitudinal manifold
12. Coolant - engine oil heat exchanger

Page Reference:
- Expansion tank: Pag. 07-5
- Radiator: Pag. 07-10
- Cooling fan: Pag. 07-13
- Fan control thermal contact: Pag. 07-14
- Thermostat unit: Pag. 07-9
- Coolant temperature gauge transmitter and max. temp. warning light contact: Pag. 07-14
DESCRIPTION

The cooling system is of the sealed type with forced circulation by a centrifugal pump (1) located on the cylinder head and operated by the timing gear belt. A thermostatic valve (2), fitted on the rear of the engine near the thermostat case, opens when the coolant reaches a temperature of 83 °C. The radiator (4) cools the engine fluid by the dynamic air and also by a fan (3) which is turned on:
- for the "95 Versions" (M2.10.3 injection-control system) by a thermal contact (5) on the radiator;
- for the "96 Versions" (M2.10.4 injection-control system) directly by the MOTRONIC control unit, depending on the signal received from the engine coolant temperature sensor (NTC).

OPERATION OF THE CIRCUIT

After the fluid has cooled the engine, it leaves the cylinder head and reaches the thermostat unit (92). From here, if the temperature is below 83 °C, it is drawn into the pump (1) through a longitudinal coolant return manifold located on the left-hand side of the cylinder head.

CHECKING THE LEVEL AND CHANGING THE ENGINE COOLANT FLUID

Checking

- With the engine cold, visually check that the level of the coolant reaches the notch indicated by the arrow on the header tank, otherwise fill the system with the specified fluid.

Draining and replenishing

- Set the car on a lift.
- Slacken and remove the header tank plug.

WARNING:
- Absolutely never remove the header tank plug when the engine is hot!
- Raise the car.

1. Slacken the radiator outlet hose and drain the coolant into a suitable recipient.

WARNING:
The anti-freeze mixture used as coolant can harm the paintwork; therefore avoid any contact with painted components.

EXPANSION TANK

The expansion tank supplies the circuit and absorbs the variations in coolant volume due to the changes in engine temperature. The tank also allows air, collected through the pipe coming from the throttle body, to bleed from the system by way of a calibrated valve in the pressurized cap. This valve also acts as a washing function enabling outside air to enter the system to compensate for the vacuum created as the system cools.

REMOVAL/REFITTING

- Drain the engine cooling system (see relative paragraph).
1. Disconnect the electrical connection of the engine coolant fluid minimum level warning light sensor.
2. Loosen the two clamps and disconnect the coolant delivery and return hoses from the expansion tank.
3. Unscrew the three screws and remove the expansion tank.
PRESSURIZED CAP SEALING TEST

- Perform the test using a seal test tool.
- Screw the fitting to the lower end of the test tool.
- Install the expansion tank pressurized cap onto the fitting of the test tool.
- Manually operate the piston of the test tool and pressurize the cap. Check that the valve opens at the specified pressure read from the manometer.

<table>
<thead>
<tr>
<th>Pressurized cap setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.96 ± 0.1 bar</td>
</tr>
</tbody>
</table>

HYDRAULIC SYSTEM PROOF TEST

- Unscrew and remove the pressurized cap from the expansion tank.
- Screw the hydraulic system proof testing tool and relevant fitting onto the expansion tank filter neck.
- Manually pressurize the circuit and check that the pressure is maintained at the specified value. If the pressure is incorrect, check that there are no leaks in the radiator or sleeves.

<table>
<thead>
<tr>
<th>Hydraulic system test pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.06 bar</td>
</tr>
</tbody>
</table>

WATER PUMP

The water pump is of the centrifugal type with blades. It is fastened to the cylinder head and operated by the crankshaft via the timing gear belt. An O-Ring ensures tightness between the cylinder head and the pump. The water pump is kept running constantly to ensure that the coolant fluid circulates continuously.

1. Pulley   4. O-Ring
2. Impeller 5. Bearing
3. Pump casing

REMOVAL/REFITTING
(For engines with counter-rotating shafts)

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Drain the engine cooling system (see relative paragraphs).
- Slacken the screws and move the header tank to one side without disconnecting the piping.

3. Slacken the the fastening screws and remove the lower cover of the timing gear and counter-rotating shaft drive belts.

- Slacken the the lower screws of the upper cover of the timing gear and counter-rotating shaft drive belts.
1. Lower the car, slacken the the fastening screws and remove the the upper cover.

1. Raise the car and working as illustrated on the belt tensioner loosen the tension of the auxiliary components drive belt and remove it.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.

3. Slacken the the fastening screw and remove the belt tensioner.
2. Slacken the the fastening screw and remove the auxiliary components drive belt guide pulley.
1. Slacken the fastening screw and remove the socket for the oil vapour recovery pipe.

2. Disconnect the electrical connections from the ignition coils.

1. Slacken the fastening screws and remove the ignition coils cover.

1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.

1. Working on the timing gear belt tensioner, loosen the tension on the belt, then take it off the timing gear drive pulleys.
2. Slacken the four screws fastening the timing gear intake side drive pulley and remove it.

1. Using tools no. 1.822.146.000 and no. 1.822.156.000 slacken the screw fastening the timing gear exhaust side drive pulley and remove it.

1. Slacken the fastening screws and remove the side protection on the exhaust side.
2. Remove the two fastening screws and remove the water pump complete with O-Ring.

1. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.
3. Slacken the lower screws of the cover of the timing gear drive belt.
1. Lower the car, slacken the fastening screws and remove the cover of the timing gear drive belt.

REMOVAL/REFITTING (For engines without counter-rotating shafts)
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Drain the engine cooling system (see relative paragraph).
- Slacken the screws and move the header tank to one side without disconnecting the piping.
1. Raise the car and working as illustrated on the belt tensioner loosen the tension of the auxiliary components drive belt and remove it.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.

For refitting the timing gear drive belt and timing and for assembly of the auxiliary components drive belt see GROUP 00.
1. Slacken the fastening screws and remove the ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.

1. Slacken the fastening screws and remove the cylinder head cover complete with gasket.

1. Working on the timing gear belt tensioner, loosen the tension on the belt, then take it off the timing gear drive pulleys.

21 - 26 Nm
2.1 - 2.7 kNm

1. Using tools no. 1.822.146.000 and no. 1.822.156.000 slacken the screw fastening the timing gear exhaust side drive pulley and remove it.
2. Slacken the four screws fastening the timing gear intake side drive pulley and remove it.

- Refit reversing the sequence followed for removal.

For refitting the timing gear drive belt and timing and for assembly of the auxiliary components drive belt see GROUP 06.

1. Disconnect all the pipes connected to the thermostat unit.
2. Slacken the fastening screws and remove the thermostat unit.

**THERMOSTAT UNIT**

The thermostat unit is fitted on the rear end of the cylinder head. Its purpose is to prevent the engine from exceeding the optimum temperature: until the coolant temperature reaches 83 °C, the thermostatic valve diverts the coolant fluid towards the pump; at higher temperatures, the opening of the thermostatic valve enables the passage of the fluid towards the radiator.

On the thermostat unit there is a sensor (NTC) for detecting the coolant temperature to be sent to the control unit.

1. Slacken the fastening screws and remove the side protection on the exhaust side.
2. Remove the two fastening screws and remove the water pump complete with O-Ring.

- Remove the battery
1. Drain the engine coolant fluid disconnecting the radiator delivery sleeve from the thermostatic cup.
2. Disconnect the electrical connection from the engine coolant temperature sensor (NTC).
**RADIATOR**

The radiator is sized to meet the heat dispersal requirements when the engine is running. It comprises a radiator mass and two side reservoirs fitted with inlet and outlet unions for the coolant fluid: the pipes and radiator mass fins are in aluminium, the reservoirs are in plastic.

**REMOVING/REFITTING**

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Drain the coolant fluid from the air conditioning system (see specific paragraph).

1. Raise the car and drain the engine coolant fluid disconnecting the radiator outlet sleeve.
2. Disconnect the electrical connection from the solenoid valve control thermal contact ( '95 versions).

1. Slacken the fastening screws and remove the air inlet pipe from the crossmember.

1. From the radiator disconnect the coolant sleeve leading from the thermostatic cup.

1. Disconnect the electrical connections from the cooling fan.

1. Central detachment of the two grille trim profiles.

1. Remove the grille (see specific paragraph).

1. Remove the front bumper (see specific paragraph).

1. Release the power steering pipes from the fastenings on the lower radiator crossmember.
1. Remove the two screws fastening the lower radiator crossmember to the body.

1. Remove the radiator, condenser, fan and lower radiator crossmember assembly withdrawing from below.

1. Raise the car and disconnect the two coolant inlet and outlet pipes from the conditioner condenser.
2. Slacken the two upper radiator fastening screws.
DIS-ASSEMBLY

1. Remove the lower crossmember from the radiator.

1. Slacken the six fastening screws and separate the air duct from the radiator.

1. Slacken the three fastening screws, then remove the complete fan.

1. Slacken the four fastening screws, then remove the air intake pipe from the crossmember.

1. Remove the fan control thermal contact from the radiator (95 versions).

COOLING FAN

The cooling fan makes it possible to increase the heat dispersion capacity of the radiator.

The fan is turned on by:
- for the "95 Versions" (M2.10.3 injection-ignition system) by a thermal contact on the radiator;
- for the "96 Versions" (M2.10.4 injection-ignition system) directly by the MOTRONIC control unit, depending on the signal received from the engine coolant temperature sensor (NTC).

(For further details about how the fan works, see ELECTRIC ELECTRONIC DIAGNOSIS - Sect. 26 for versions with air conditioner and Sect. 28 for versions without air conditioner).

REMOVING/REFITTING

- Disconnect the battery (-) terminal.
- 1. Slacken the fastening screws and remove the air intake pipe from the crossmember.

1. Disconnect the electrical connections from the cooling fan.

DIS-ASSEMBLY

1. Slacken the three fastening nuts and remove the heat shield.

1. Slacken the three fastening nuts, then separate the fan from the duct.
2. Remove the additional resistance slackening the two fastening screws.
FAN CONTROL THERMAL CONTACT (Specific for '95 versions)

REMOVING/REFITTING
- Set the car on a lift.
- Disconnect the battery (-) terminal.
1. Raise the car and disconnect the electrical connection of the fan control thermal contact.
2. Slacken and remove the fan control thermal contact and recover the coolant fluid that comes out.

CHECKS AND INSPECTIONS
Check the setting of the thermal contact referring to the wiring diagram (see "Electric System Diagnosis").

<table>
<thead>
<tr>
<th>Cut-in/cut-out temperatures of cooling fan</th>
<th>1st speed</th>
<th>2nd speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut-in (contacts closed)</td>
<td>92 ± 2°C</td>
<td>92 ± 2°C</td>
</tr>
<tr>
<td>Cut-out (contacts open)</td>
<td>87 ± 2°C</td>
<td>97 ± 2°C</td>
</tr>
</tbody>
</table>

- Change the thermal contact if the values are not correct.

COOLANT TEMPERATURE GAUGE TRANSMITTER AND MAXIMUM TEMPERATURE WARNING LIGHT CONTACT

REMOVING/REFITTING
- Disconnect the battery (-) terminal.
- Disconnect the electrical connection from the electric coolant temperature sensor (NTC).
1. Disconnect the electrical connection from the engine coolant gauge transmitter and maximum temperature warning light contact, then remove it retrieving the coolant fluid that comes out.

CHECKS AND INSPECTIONS
Check the setting of the transmitter referring to the wiring diagram (see "Electric System Diagnosis").

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Resistance (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 (test fluid water)</td>
<td>525 - 605</td>
</tr>
<tr>
<td>90 (test fluid water)</td>
<td>195 - 245</td>
</tr>
<tr>
<td>120 (test fluid glycerine)</td>
<td>82 - 94</td>
</tr>
</tbody>
</table>

| Contact closing temperature | 122 ± 2°C | 120 ± 2°C |
| Contact opening temperature | 112 ± 3°C | 108 ± 2°C |

COOLING FAN THERMAL CONTACT (Specific for '95 versions)

<table>
<thead>
<tr>
<th>Fan cut-in/cut-out temperature</th>
<th>1st speed</th>
<th>2nd speed</th>
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<tr>
<td>Cut-in (contacts closed)</td>
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<td>92 ± 2°C</td>
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<tr>
<td>Cut-out (contacts open)</td>
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COOLANT TEMPERATURE GAUGE TRANSMITTER AND MAX. TEMPERATURE WARNING LIGHT CONTACT

<table>
<thead>
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<th>Temperature (°C)</th>
<th>Resistance (Ω)</th>
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<tr>
<td>60 (test fluid water)</td>
<td>525 - 605</td>
</tr>
<tr>
<td>90 (test fluid water)</td>
<td>195 - 245</td>
</tr>
<tr>
<td>120 (test fluid glycerine)</td>
<td>82 - 94</td>
</tr>
</tbody>
</table>

| Contact closing temperature | 122 ± 2°C | 120 ± 2°C |
| Contact opening temperature | 112 ± 3°C | 108 ± 2°C |

TIGHTENING TORQUES

<table>
<thead>
<tr>
<th>Part</th>
<th>Nm</th>
<th>kgm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary components drive belt pulley fastening screws</td>
<td>24 - 29</td>
<td>2.4 - 3.0</td>
</tr>
<tr>
<td>Timing gear belt fastening nut</td>
<td>21 - 26</td>
<td>2.1 - 2.7</td>
</tr>
<tr>
<td>Exhaust side timing gear belt drive pulley fastening screws</td>
<td>100 - 124</td>
<td>10.2 - 12.6</td>
</tr>
</tbody>
</table>