Installation and service manual

CC5 roof-top air-conditioning system

01/2003

67009C

TABLE OF CONTENTS

1. INTRODUCTION 4
1.1. Contents and purpose 4
1.2. Meaning of signal words 4
1.3. Additional documents to be used 4
1.4. Safety notes and regulations 4
1.5. Certification 5
1.6. Suggestions for improvements and changes 5
2. GENERAL DESCRIPTION 6
2.1. Roof-top air-conditioning unit 6
2.2. Compressor 9
2.3. Electrical system 9
2.4. Principles of operation of the air-conditioning system 9
2.5. Design, function and principle of operation of the assemblies 12
3. TECHNICAL DATA 14
3.1. Air-conditioning system 14
3.2. Electric fuses 14
3.3. Compressor 15
3.4. Circuit diagram of baseline version 16
3.5. Circuit diagram of deluxe version 17
4. INSTALLATION INSTRUCTIONS 18
4.1. Safety notes 18
4.2. Installation kit 18
4.3. Parts not included in standard installation kit and to be made by the customer 18
4.4. Vehicle-specific parts not included in the installation kit and to be procured by the customer 18
4.5. Required equipment, special tools and accessories 19
4.6. Preparations on vehicle / cab roof 19
4.7. Manufacture / procurement of the compressor mounting bracket 20
4.8. Manufacture of hose lines 21
4.9. Installation of roof-top air-conditioning unit with air distribution panel 25
4.10. Install the compressor 29
4.11. Make electrical connections 29
4.12. Prepare and install the refrigerant lines in the vehicle 30
4.13. Leak test and evacuate the system 31
4.14. Fill the system with refrigerant 32
4.15. Completion 34

5. START-UP 35
5.1. Safety notes 35
5.2. Operator notes 35
5.3. Operating and control elements 36
5.4. Initial start-up 36
5.5. Operation 36
5.6. Operation of the air-conditioning system (deluxe version) 37
6. MAINTENANCE 38
6.1. Safety notes 38
6.2. General 38
6.3. Maintenance and care 38
6.4. Maintenance and care checklist 39
6.5. Inspections prior to repair 39
6.6. Troubleshooting 40
6.7. Repair work 41
6.8. Post-repair procedures and testing 42
6.9. Visual inspection 43
7. WARRANTY CLAIMS 44

1. INTRODUCTION

1.1. Contents and purpose

This installation and service manual is designed to assist trained personnel and contains important installation, operation and maintenance information relating to the CC5 roof-top air-conditioning system.

1.2. Meaning of signal words

Throughout this manual, the signal words WARNING, CAUTION and NOTE have the following meanings:

WARNING

This heading is used to highlight operating instructions or procedures which, if not or not correctly followed, may result in personal injury or fatal accidents.

CAUTION

This heading is used to highlight operating instructions or procedures which, if not or not correctly followed, may result in damage to the equipment or its components.

NOTE

This heading is used to direct your attention to a special feature deemed essential to highlight.

1.3. Additional documents to be used

a) Operating manual for the CC5 roof-top air-conditioning system

1.4. Safety notes and regulations

The CC5 roof-top air-conditioning system has been designed and is produced in accordance with EC Directives.

The system is safe to operate provided it is properly installed and used in accordance with the instructions contained in this installation and service manual.

If the vehicle height stated in the vehicle registration document is exceeded due to the installation of the roof-top air-conditioning system, it must be legalised through a type approval in accordance with § 19 of the German Road Traffic Act.

In principle, the following general accident prevention regulations and current works safety instructions are applicable:

- Safety regulations concerning the construction and operation of earth-moving machinery of the German employers' liability insurance association for civil engineering (Technischer Aufsichtsdienst, Landsberger Straße 309, 80687 Munich)
- DIN ISO 3471 Roll-over protective structures
- DIN ISO 3449 Falling object protective structures
- DIN ISO 3411 Human physical dimensions of operators, minimum operator space envelope
- Guidelines, safety regulations, rules, principles and leaflets of technical committees at the Berufsgenossenschaftlichen Zentrale für Sicherheit und Gesundheit -BG7- des Hauptverbandes der Gewerblichen Berufsgenossenschaften (Carl Heymanns Verlag KG, Luxemburger Staße 449, 50939 Cologne)

The "General safety regulations" that go beyond the scope of the above regulations are stated below.

Any special safety regulations relevant to the present instruction manual will be highlighted in the relevant sections or text passages of the procedures.

General safety regulations

Webasto will not accept any liability if the installation instructions and the notes contained therein are not observed. The same applies to improperly performed repairs or repairs where parts other than genuine spare parts are used. In those cases, the vehicle's "General Operating Permit" (homologation) may be invalidated as a consequence.

The electric cables and controls for the air-conditioning system must be arranged in the vehicle so that their proper functioning cannot be adversely affected in normal operating conditions.

Safety notes on maintenance work

If malfunctions occur in the refrigerant system, the system must be checked and properly repaired by a specialised service centre. Never release the refrigerant into the atmosphere (§ 8, Directive on the Prohibition of CFC-Halon Substances dated 06.05.1991).

Never heat refrigerant bottles using an open flame.

Liquid refrigerant must not come into contact with the skin. The relevant safety data sheet is to be observed.

When handling refrigerant, wear protective clothing and safety goggles.

WARNING

Do not carry out any soldering or welding work directly on parts of the sealed refrigeration circuit or in its immediate vicinity. The extreme heat will cause the pressure in the system to rise. Danger of explosion.

Allow the system to cool fully before starting any work on it. There is a risk of scalding from the condenser, the compressor and the hoses.

Installation, maintenance and repair work must be carried out by trained personnel only. This work may only be carried out with the engine at a standstill and the power supply switched off.

Always disconnect the battery before you open the roof-top air-conditioning unit, remove the compressor, or work on the electrical cabling.

Do not wear any metal jewellery when working on electrical components (take off bracelets, watches, necklaces and rings).

1.5. Certification

a) The unit has been tested for electromagnetic compatibility.

b) Compliance with standard EN 45014 has been assured.

c) The CE mark has been affixed to the roof-top air-conditioning system.

1.6. Suggestions for improvements and changes

Complaints, improvement suggestions or corrections relating to this manual should be addressed to:

Webasto Thermosysteme GmbH
Technical Documentation Dept.
D-82131 Stockdorf
Phone: 089 85794-542
Fax: 089 85794-757

2. GENERAL DESCRIPTION

The CC5 roof-top air-conditioning system (Fig. 2.1) consists of the roof-top air-conditioning unit (1) and the compressor (2). These components are connected by 2 hoses (3) thus forming the refrigeration system. The system is supplied with electrical power from the vehicle power supply via cables (4). The system is available in 12 V and 24 V versions to suit the vehicle's electrical system.

The CC5 roof-top air-conditioning system is designed for the cooling/air-conditioning of truck cabs as well as the driving cabs of agricultural machinery, earth-moving machinery, airport vehicles, municipal vehicles, and for air-conditioning the driver's seat in buses.

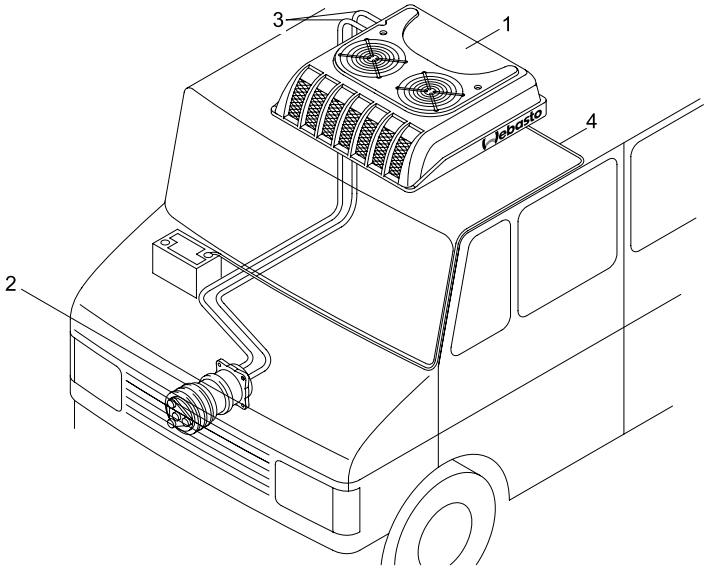


Fig. 2.1

NOTE

Vehicles to be fitted with a roof-top air-conditioning system must have a drive belt pulley for an auxiliary compressor drive, or be prepared for the installation of a compressor in the main belt drive.

2.1. Roof-top air-conditioning unit

The roof-top air-conditioning unit is illustrated in Fig. 2.2.

It comprises the following:

– The cover (1), featuring openings and protective grilles for the air inlet and outlet, marks the external contour of the unit.
– The base plate (8), which serves as the load-bearing structural member.

  The following elements are incorporated therein:

  – Radial fan (5),
  – Collector and drier (13) with inspection window (14), and pressure cut-out switch (15),
  – Condenser (3),
  – Evaporator (6) with mist separator (7),
  – Expansion valve (11),
  – De-icer switch (12),
  – Clip connections (9, 10),
  – Relay (16) and blade-type fuse holder (17),
  – Wiring harness with cable grommet (26),
  – Axial fan (4).

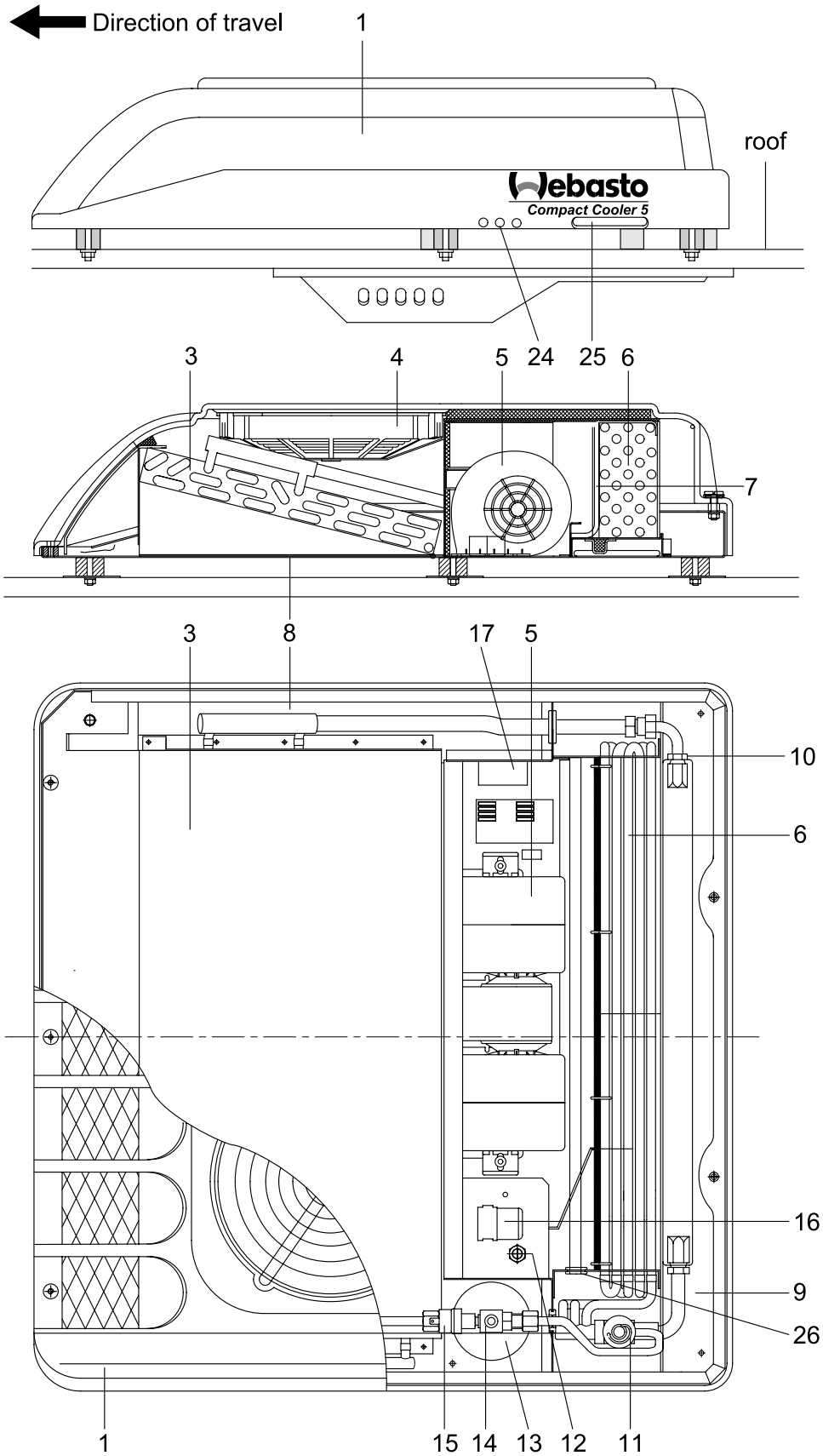

Direction of travel
1
roof
Webasto
Compact Cooler 5
3
4
5
24
25
6
7
3
8
17
5
10
6
16
9
26
1
15
14
13
12
11

Fig. 2.2

In addition to the roof-top unit, the delivery also includes the air distribution panel (Fig. 2.2a). Control elements such as the ON / OFF rocker switch (1) and the rocker switch for the fan (2) can be integrated into the air distribution panel.

In the deluxe version, an electronic thermostat is also integrated into the roof-top unit. A setpoint generator potentiometer (3, Fig. 2.2a), which can be installed in the air distribution panel, is supplied for setting the temperature.

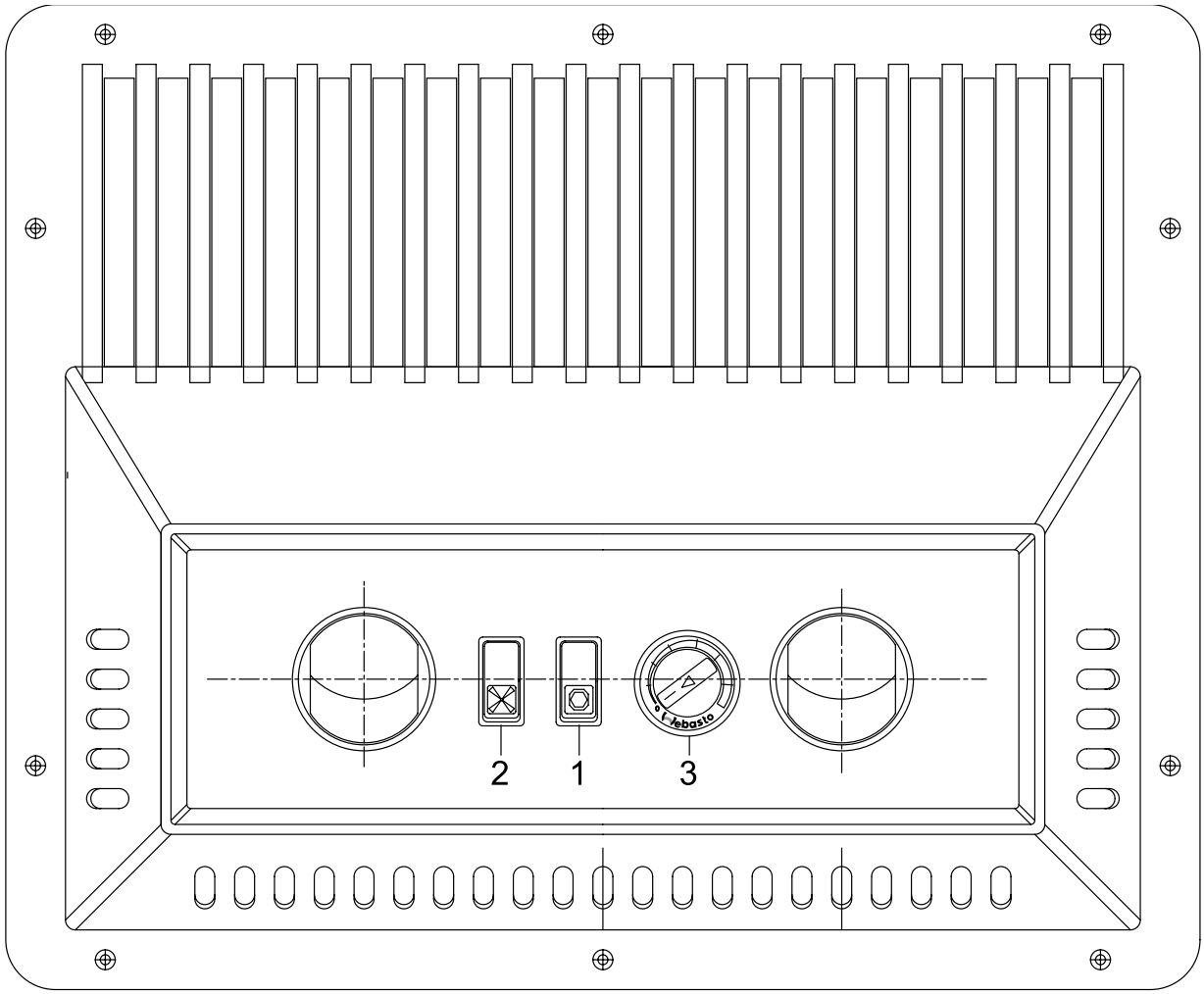


Fig. 2.2a

(1) Air conditioning system ON/OFF

(2) 3-setting rocker switch

(3) Setpoint generator potentiometer

2.2. Compressor

The compressor (Fig. 2.3), a swash plate compressor, is available in six different versions:

– TM-13HD h, with horizontal refrigerant connections and twin V-belt pulley, 12 V

– TM-13HD h, with horizontal refrigerant connections and twin V-belt pulley, 24 V

– TM-13HD v, with vertical refrigerant connections and twin V-belt pulley, 12 V

– TM-13HD v, with vertical refrigerant connections and twin V-belt pulley, 24 V

– TM-13HD h, with horizontal refrigerant connections and Poly V8-belt pulley, 24 V

– TM-13HD v, with vertical refrigerant connections and Poly V8-belt pulley, 12 V

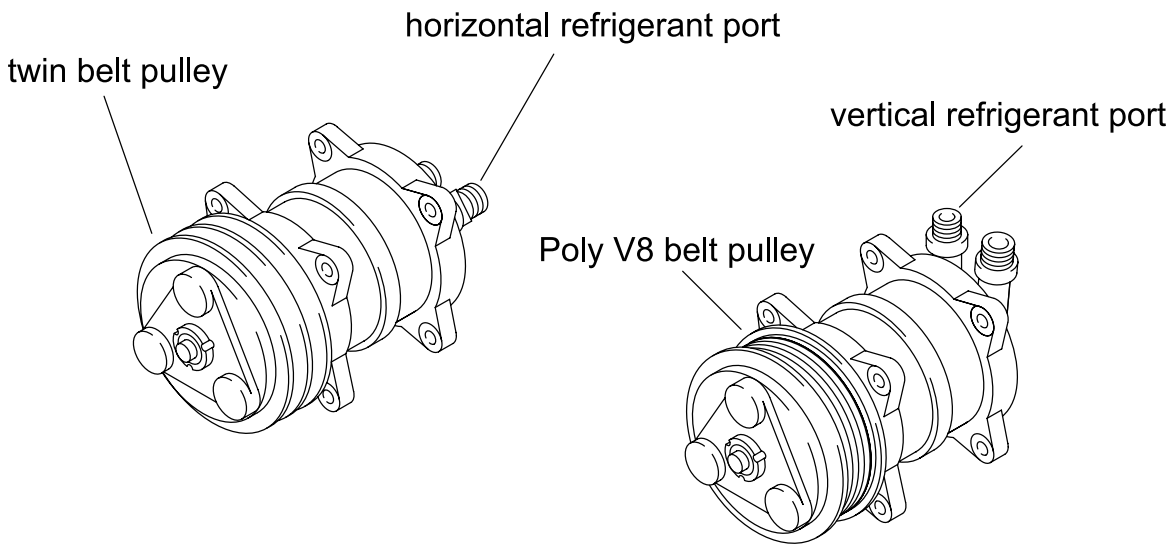


Fig. 2.3

2.3. Electrical system

The electrical connection of the units is to be made as shown in the circuit diagrams in Figs. 3.1 and 3.2.

The connection should be made via a battery discharge protection circuit with integrated fuse. In this way, the system can only be operated when the vehicle engine is running.

2.4. Principles of operation of the air-conditioning system

When the air-conditioning system is switched on using the ON / OFF rocker switch in the air distribution panel, the compressor (18, Fig. 2.4) engages via the electromagnetic clutch and is driven by the vehicle engine via the drive belt. The compressor compresses the refrigerant gas and transports it to the condenser (3), where it gives off heat as it condenses.

The resultant condensation heat is given off into the ambient air as it passes through it (19 and 20 Fig. 2.4 and Fig. 2.5). The two axial fans (4) provide adequate ventilation even when the vehicle is not in motion.

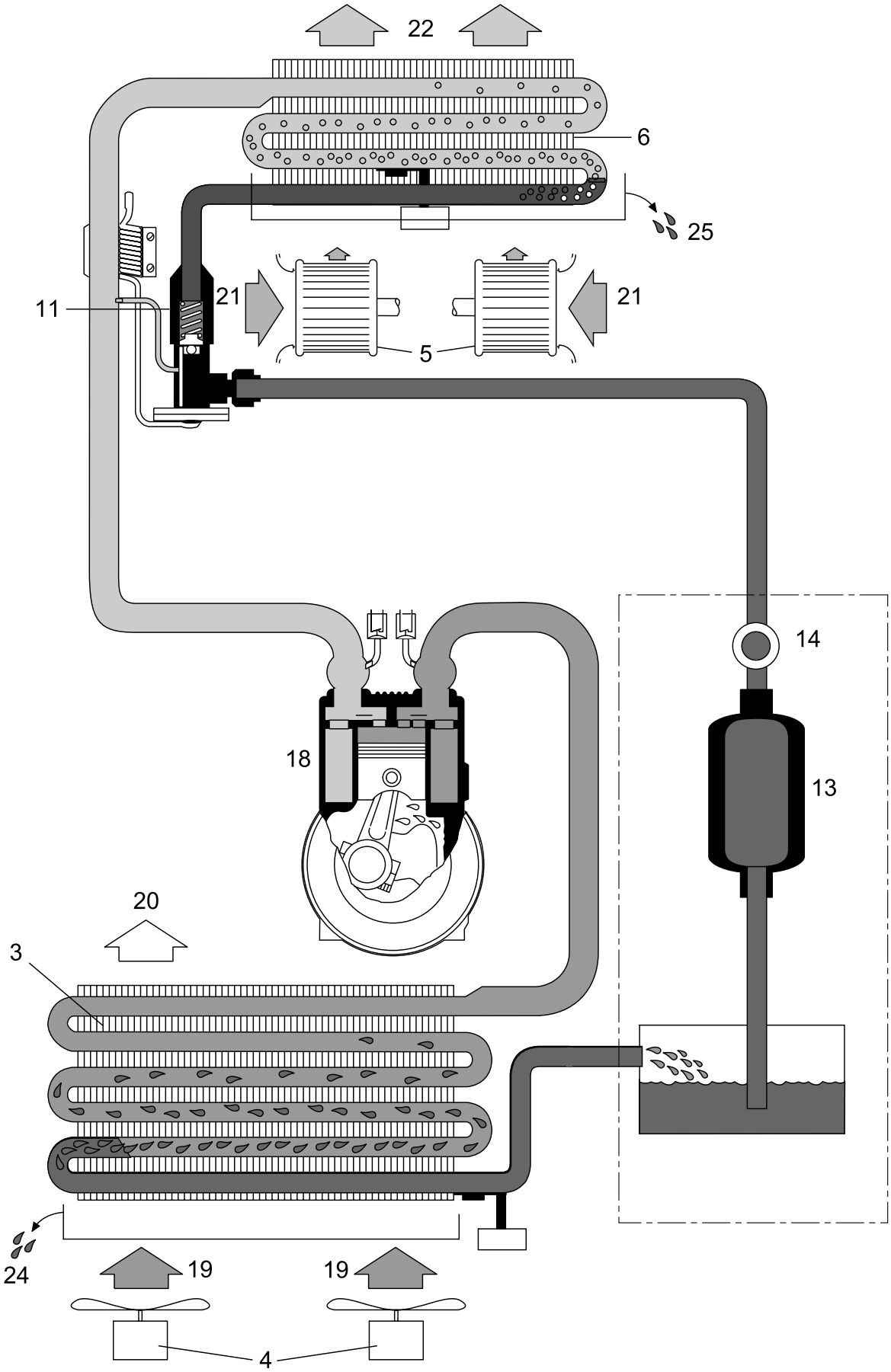


Fig. 2.4

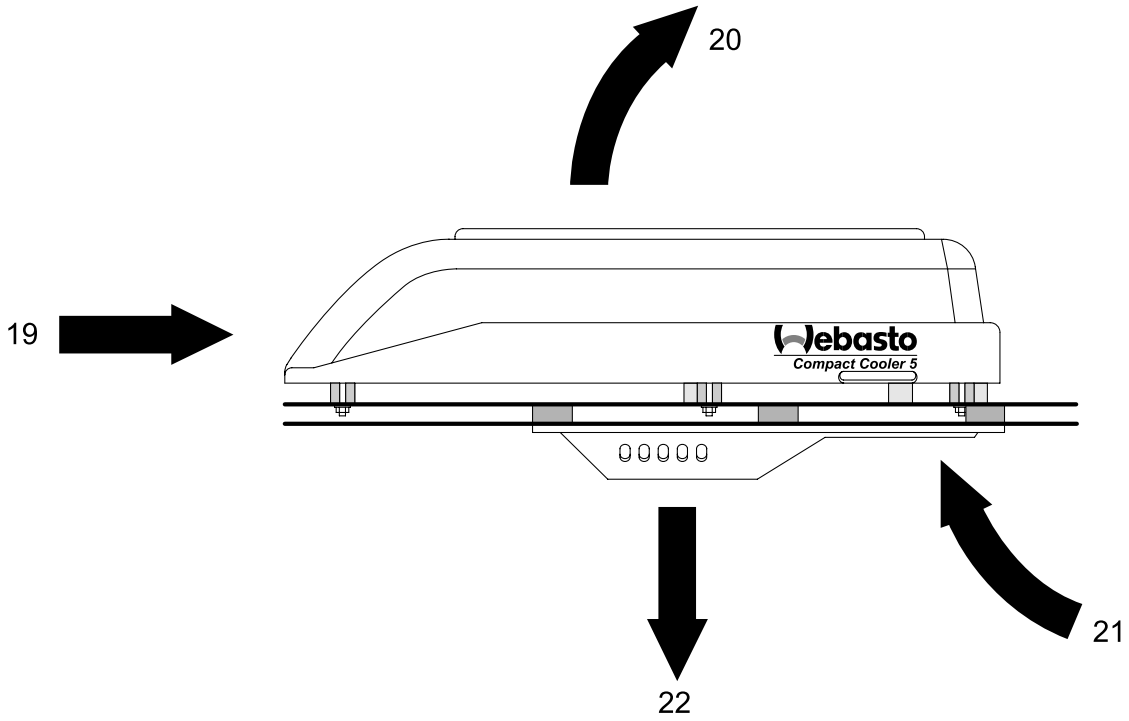


Fig. 2.5

The liquid refrigerant flows through the collector-drier (13) to the expansion valve (11), where it is allowed to expand by virtue of a controlled fall in pressure, and then evaporates again in the evaporator (6) whilst absorbing a large amount of heat.

The warm recirculated air (21) in the vehicle cab is drawn in by the radial fan (5), then cooled in the evaporator, dried and returned to the cab via the air distribution panel (22). Any condensation generated during this process is separated and fed to the outside via the drain opening (25).

During operation, the refrigeration system is monitored by the de-icer switch (12) (S2, see circuit diagram Fig. 3.1 or 3.2) and the pressure cut-out switch (15) (S3, see circuit diagram Fig. 3.1 or 3.2). These two switches switch the magnetic clutch on and off and thus engage and disengage the compressor.

When the air-conditioning unit is switched off at the ON / OFF rocker switch, the electromagnetic clutch and the fan motors are disconnected from the power supply. The refrigeration system and the recirculated air system are deactivated.

Any rainwater that gets into the roof-top unit is discharged via the drain opening (24, Fig. 2.2).

2.5. Design, function and principle of operation of the assemblies

Condenser

The condenser (3, Fig. 2.2) is made up of continuous coiled tubing and fins, which are interconnected to form a large heat exchanger surface.

It cools the hot refrigerant gas so that it liquefies and supercools, and it transfers the condensation heat, through the fins, to the ambient air flowing through it.

Collector-drier

The collector-drier has an inspection window (13, Fig. 2.2) and acts as an expansion and storage tank for refrigerant. In its lower part it contains desiccant granules that remove and chemically bind small amounts of water present in the refrigerant. This reduces the formation of ice in the expansion valve and protects the compressor against damage. During operation, the inspection window (14, Fig. 2.2) indicates if there is an adequate amount of refrigerant in the system.

Thermostatic expansion valve

The thermostatic expansion valve (15, Fig. 2.2) controls the refrigerant flow to the evaporator to meet the refrigerant demand and/or the temperature in the evaporator. The thermostatic expansion valve constitutes the control element between the high and low pressure sides of the refrigeration system.

Evaporator

The basic design of the evaporator (6, Fig. 2.2) is identical to that of the condenser. In the evaporator, the refrigerant flowing from the expansion valve through the evaporator tubing is converted from a liquid to a vapour state and is superheated.

The evaporation heat required for this purpose is extracted, via the fins, from the cab air flowing through them and is transferred to the refrigerant via the walls of the hoses. The cooling air is dried and any condensation water that may have formed is discharged to the outside. The mist separator (7, Fig. 2.2) prevents condensation water droplets from being drawn in by the radial fan and getting into the interior of the vehicle.

Pressure cut-out switch

The pressure cut-out switch (11, Fig. 2.2) comprises a high pressure and a low pressure switch. It monitors the pressure on the high pressure side of the refrigeration system and uses the electromagnetic clutch to switch off the compressor if the pressure is too low (for example due to refrigerant loss) or too high (for example due to condenser overheating).

De-icer switch

The de-icer switch (12, Fig. 2.2) is a temperature switch. It measures the temperature between the fins of the evaporator and shuts off the power supply to the electromagnetic clutch of the compressor if there is a danger of ice formation (approx. 0 °C) and switches it on again when the temperature has risen to approx. 3 °C.

Axial fans

The two axial fans (4, Fig. 2.2) consist of a DC motor, fan impeller, enclosure, and protective grille. Once the air-conditioning unit has been switched on they have a permanent voltage supply, via the relay (K1, Fig. 3.1), from the vehicle’s electrical system and provide the condenser with the ambient air it requires.

Radial fan

The radial fan (5, Fig. 2.2) contains a multi-speed DC motor. It draws in the cab air through the evaporator and discharges it back into the cab through the nozzles in the air distribution panel (Fig. 2.2a).

Compressor

The compressor (Fig. 2.2) consists of a swash plate compressor and the electromagnetic clutch with a V-belt pulley. When the air-conditioning unit is switched on, the compressor is switch on and off by the electromagnetic clutch.

The compressor's output capacity depends on the vehicle’s engine speed. However, it is designed such that its capacity is sufficient when the vehicle engine is idling. It compresses the refrigerant to the pressure required for liquefaction.

Electronic thermostat (optional)

The deluxe version includes an electronic thermostat and a temperature probe. The air intake temperature is measured. When the temperature preset on the setpoint generator potentiometer is reached, the compressor cuts out.

3. TECHNICAL DATA

3.1. Air-conditioning system

Designation	Type CC5
Dimensions, roof-top air-conditioning unit	
Length x Width x Height	750 mm x 760 mm x 165 mm
Weight	26.5 kg
Operating voltages (depending on vehicle's electrical system)	12 Volts DC, 24 Volts DC
Power consumption	
12 Volts DC / 24 Volts DC	37 A / 20 A
Switching points, low pressure cut-out switch	
– Off	2.1 ± 0.3 bar
– On	2.0 ± 0.2 bar
Switching points, high pressure cut-out switch	
– Off	26.5 ± 2 bar
– On	20 ± 2 bar
Refrigerant	R134a
Cooling capacity	5 kW
Evaporator – air flow rate (free-blowing) without air distribution panel	630 m^3/h
Switching point, de-icer thermostat	
– Off	1 °C ± 1
– On	3.5 °C (max)

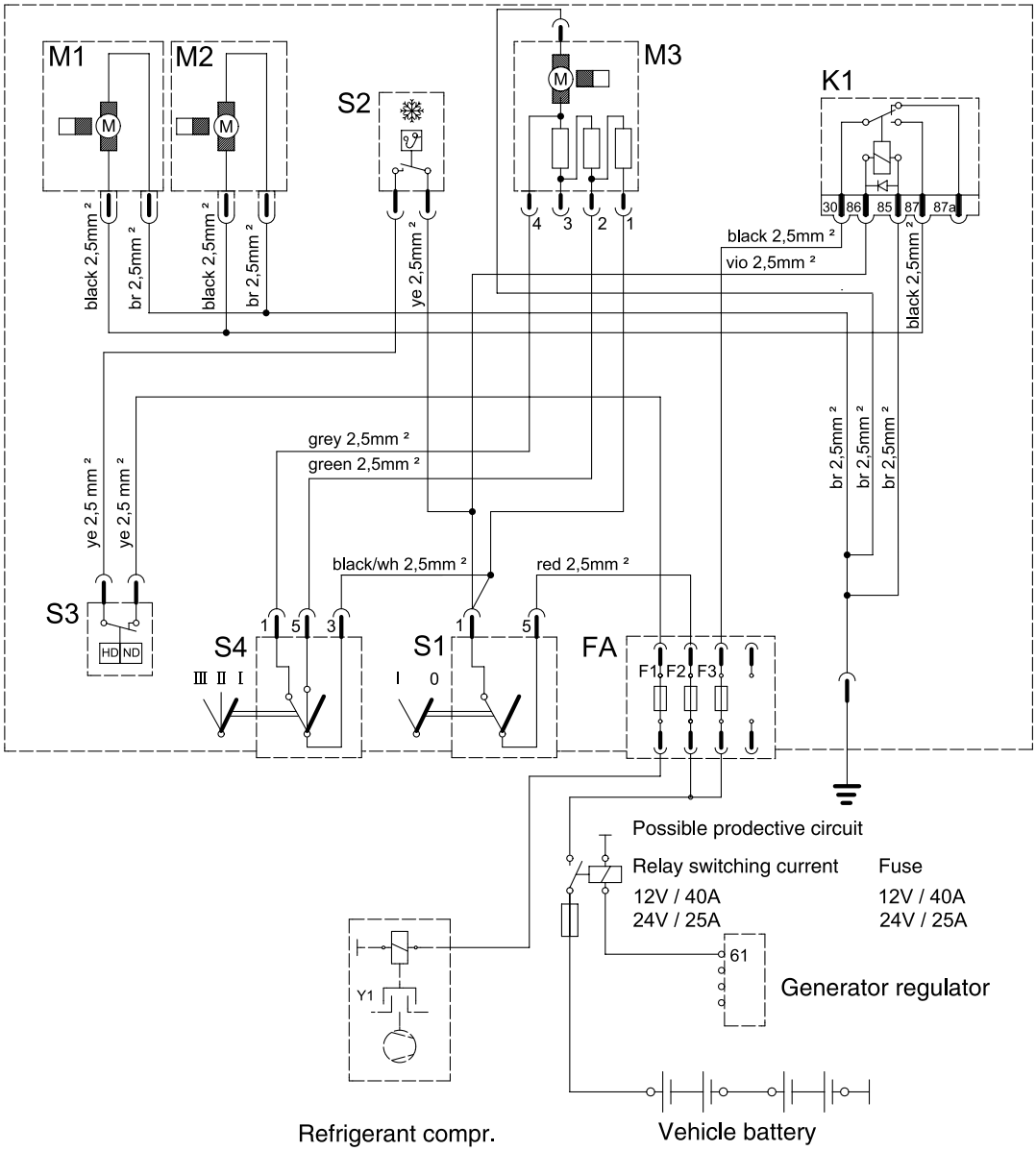
3.2. Electric fuses

Fused components	Fuse Symbol	Fuse Amperage
12 V		
– Compressor	F1	5 A
– Radial fan + compressor	F2	25 A
– 2 x axial fans	F3	25 A
24 V		
– Compressor	F1	5 A
– Radial fan + compressor	F2	15 A
– 2 x axial fans	F3	15 A

3.3. Compressor

Designation	**Type Seltec TM13 HD**
Dimensions (length x width x height)	235 mm x 124 mm x 136 mm
Weight (mass)	6.8 kg
Direction of rotation	left/right
Capacity per revolution	131 cm^3
Refrigerator oil (type / amount)	PAG ZXL 100 PG / 150 + 20 cm^3
Refrigerant connections	
– Discharge side (standard)	3/4" O-ring
– Intake side (standard)	7/8" O-ring
Installation position, pivot range	
– Around the longitudinal axis	max. ± 30°
– Around the transverse axis	max. ±10°
Electromagnetic clutch	
– Power supply	12 / 24 Volt DC
– Power consumption	max. 45 Watt
– Connector type	AMP 42060
Operating speed	850 up to max. 6000/min.
Pressure relief valve opening pressure	34.5 – 39.2 bar

3.4. Circuit diagram of baseline version

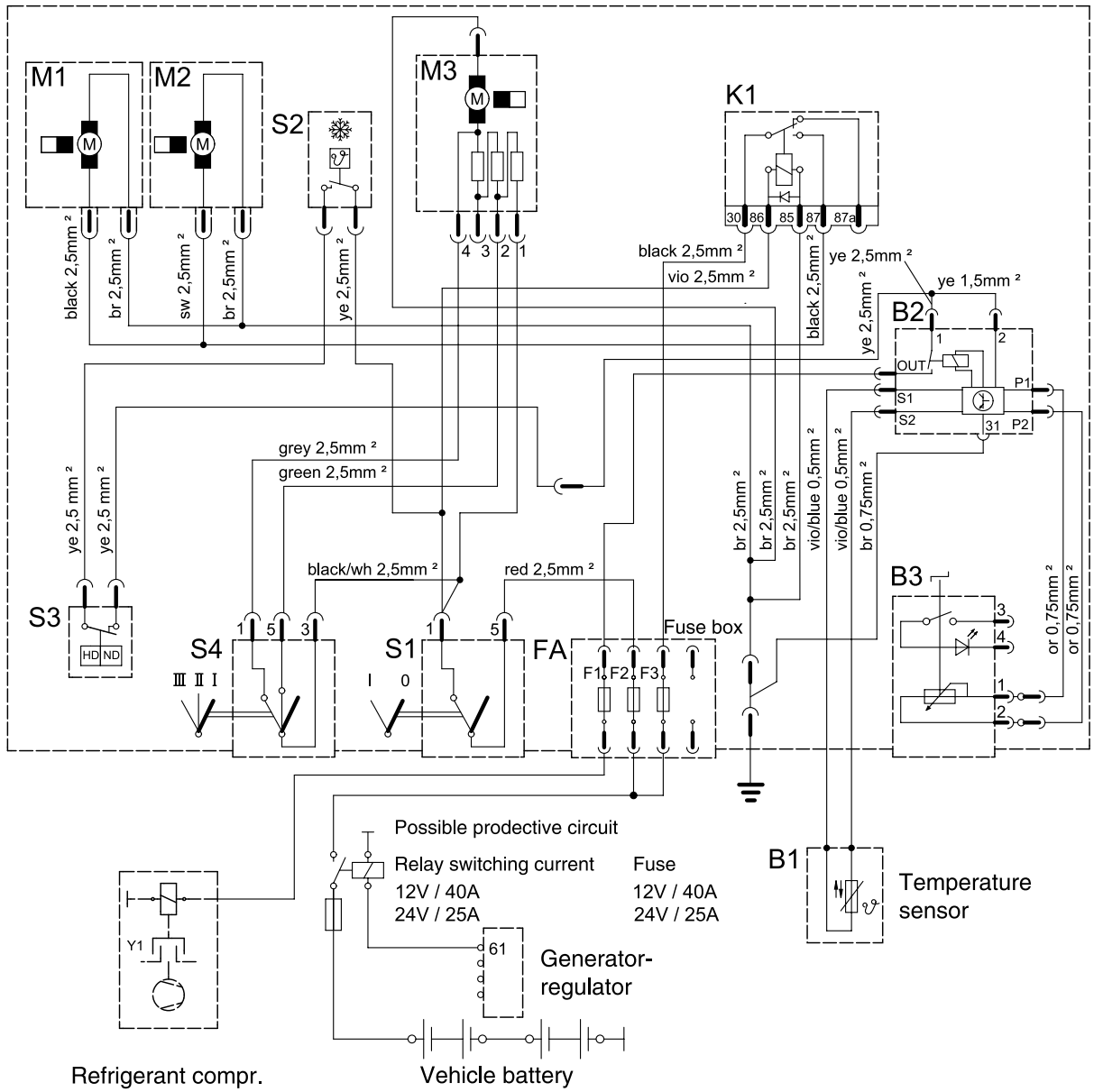


Fuse	F1,F2,F3	5A,25A,25A	5A,15A,15A
Fuse box f. 4 fuses	FA	81676	
LP/HP switch	S3	66553	
De-ice thermostat	S2		
Relay	K1	476382	34098
Rocker switch	S1,S4	66596,66595	
Axial fan	M1,M2	64505	64506
Radial fan	M3	80865	80866
Designation	Pos.	12V	24V

	Recommended cable size (vehicle side)		
	+	Chassis	Com-pressor
12V Version	6mm²	6mm²	2,5mm²
24V Version	4mm²	4mm²	2,5mm²

Fig. 3.1

3.5. Circuit diagram of deluxe version



Setpt. transmitter switch	B3	83051	
Thermostat module	B2	66783	
Temperature sensor	B1	Philips KTY 81-110	
Fuse	F1,F2,F3	5A,25A,25A	5A,15A,15A
Fuse box f. 4 fuses	FA	81676	
LP/HP switch	S3	66553	
De-ice thermostat	S2	65354	
Relay	K1	476382	
Rocker switch	S1,S4	66596,66595	
Axial fan	M1,M2	64505	
Radial fan	M3	80865	
Designation	Pos.	12V	

	Recommended cable size (vehicle side)		
	+	Chassis	Com-pressor
12V Version	6mm²	6mm²	2,5mm²
24V Version	4mm²	4mm²	2,5mm²

Fig. 3.2

4. INSTALLATION INSTRUCTIONS

4.1. Safety notes

Read and observe the safety notes contained in Chapter 1.4 prior to starting any work.

The installation work should be carried out or supervised by personnel trained in the field of automobile air-conditioning systems.

4.2. Installation kit

Apart from the main components, i.e.:

– Roof-top air-conditioning unit and air distribution panel
the basic delivery also includes the following parts and materials:

a) 6 m refrigerant hose NW10 (11 m, special design)

– Discharge line compressor / condenser

b) 6 m refrigerant hose NW12 (11 m, special design)

– Intake line evaporator / condenser

c) Clip connections and O-ring seals for a) and b)

– 1 x NW10 90° with filler neck
– 1 x NW10 90°
– 1 x NW12 90° with filler neck
– 1 x NW12 90° with flange
– 1 x M6 cylinder head screw (to secure screw fitting with flange to expansion valve)
– 0.5 m insulating tape for insulating the screw fitting on expansion valve

d) For installing the roof-mounted air-conditioning unit with air distribution panel

– 6 M6 screws and 12 large washers, 6 small washers, 6 fan-disk washers and M6 self-locking nuts
– 10 self-tapping screws
– Sikaflex sealing compound
– 3 strips of Armaflex sealing material
– 6 spacer discs

4.3. Parts not contained in the installation kit and to be provided/made by the customer

– Air duct weatherseal between roof and air distribution panel
– Electrical connecting cables and elements (on the vehicle) (see Fig. 3.1 or 3.2)
– Fastening elements for installing the refrigerant hoses and connecting cables
– Reinforcing elements, roof bows for the inside of the roof to ensure that the roof is adequately strong

4.4. Vehicle-specific parts not contained in installation kit and to be procured by the customer

– Compressor (can be supplied by Webasto)
– Fastening elements/bracket for installing the compressor, or the universal compressor bracket from Webasto
– V-belt of appropriate size to match V-belt pulley dimensions

WARNING

When selecting a compressor be sure to choose one that has a built-in high-pressure relief valve as a safety feature. The pressure relief valve opening pressure must comply with the technical data for the compressor (Chapter 3.3).

4.5. Required equipment, special tools and accessories

a) For installation

- Sheet metal cutter for cut-outs in the vehicle / cab roof
- Mechanics tool kit
- Clip pliers to install the refrigerant hoses
- Hose shears

b) For evacuating, filling and checking the refrigerant circuit

- Servicing / recycling station for R134a refrigerant
- Vacuum pump, intake rate min. 5 m^3/h, final pressure 1 Torr
- Filler hoses with fast-action connector for R134a
- Leak detector
- Digital thermometer
- Bottle of R134a refrigerant
- Recycling bottle for R134a refrigerant
- Bottle connectors R134a
- Refrigeration oil ZXL PAG 100 for Seltec compressor
- Test fittings with intake pressure and high pressure gauges
- Spring balance or scales (min. 35 kg)
- Nitrogen bottle with pressure reducer.

4.6. Preparations on vehicle/cab roof

- The method of installation depends on the type of vehicle. It is therefore essential to refer to the vehicle manufacturer's instructions.
- Fig. 4.1 shows the installation dimensions and the mounting hole pattern for the roof-top unit. The cut-outs for the air intake and discharge openings are off-centre in the base plate.

CAUTION

Be careful not to damage any supporting structures (for example roof bows and reinforcements) or interior fittings.

- Take the template out of the packaging
- Remove the intermediate roof layer and any insulation material from the area around the air ducts.
- Sketch the air duct cut-outs (hatched areas in Fig. 4.1) on the roof and cut them out.
- Align the template or air-conditioning unit (without cover) with the marked point and drill the six holes with a diameter of 7 mm.
- Remove the template or air-conditioning unit.
- Deburr/smooth the edges of cut-outs and holes and treat them with anti-corrosive paint.
- Prepare the interior of the roof so that the air distribution panel can be mounted under the roof (see Fig. 4.9).

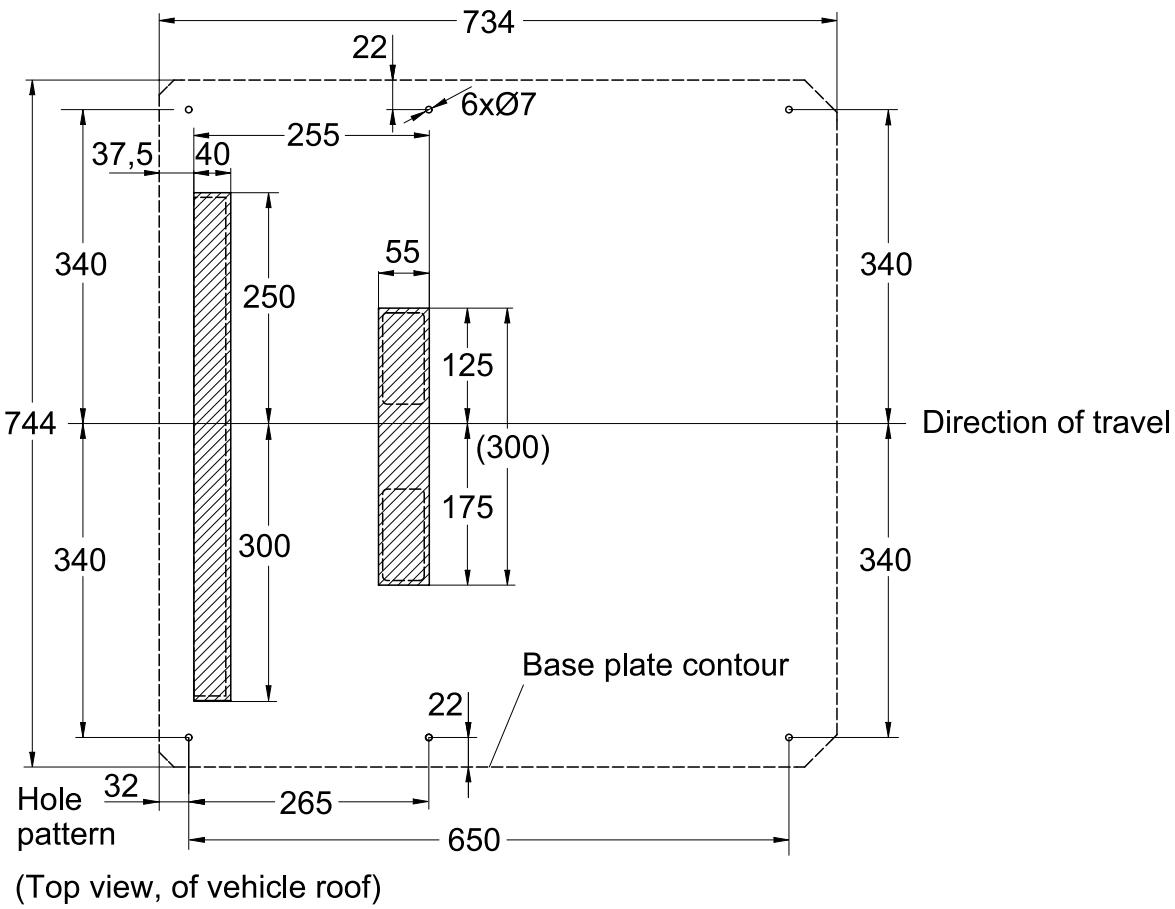


Fig. 4.1

NOTE

The cut-outs for air intake and discharge openings are off-centre.

4.7. Manufacture / procurement of the compressor mounting bracket

Fig. 4.2 shows the dimensions and mounting points for the compressor.

The compressor must be installed in accordance with the vehicle manufacturer's instructions.

The following points must also be observed when manufacturing / procuring the mounting bracket:

- Check whether compressor mounting brackets can be obtained from the vehicle manufacturer. You will need details of the chassis and engine version of the vehicle as quoted in the vehicle documents for this purpose.
- Check the availability of the universal compressor mounting bracket from Webasto (Fig. 4.3) and whether it can be used.
- Installation position of the compressor
- Select the diameter of the drive belt pulley so that it does not exceed or fall below the operating speed of the compressor.
- Ensure that V-belt pulleys on the engine and compressor are aligned.
- Sufficient V-belt wrap angle (> 120°).
- Sufficiently secure attachment of the compressor making use of a minimum of four flange holes, with a tension adjustment device for the V-belt (see Fig. 4.2).
- The position of the refrigerant connections and compressor pulley dimensions depend on the compressor used.

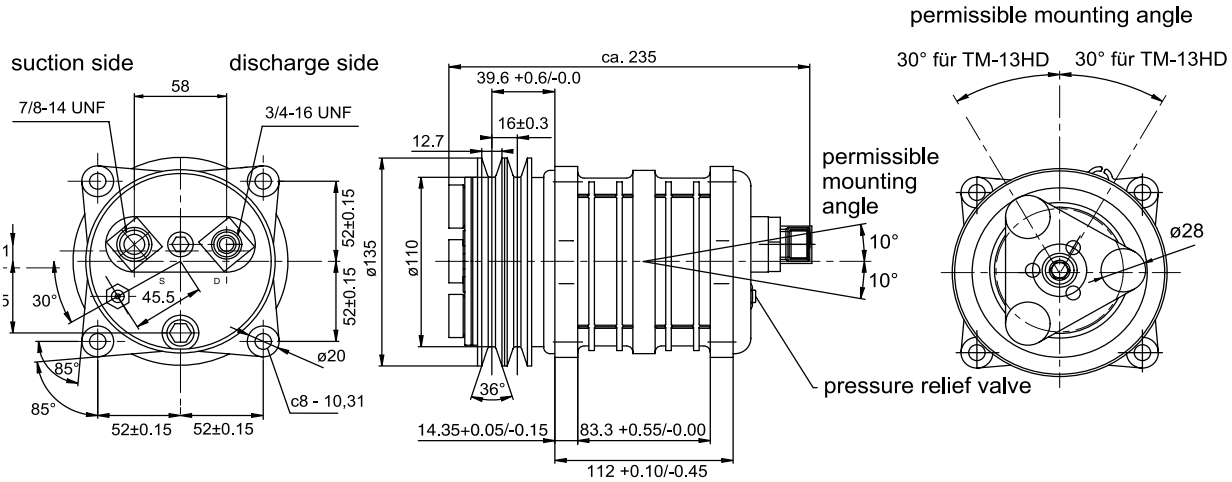


Fig. 4.2

CAUTION

Comply with the permitted installation positions of the compressor.
Non-compliance will result in compressor failure.

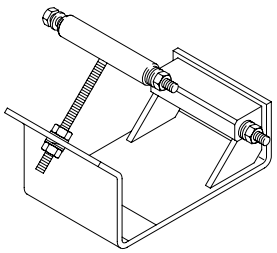


Fig. 4.3

4.8. Manufacture of hose lines

4.8.1 General information for manufacturing the hose lines

a) Select/determine location/routing of the hose lines (bear the diameter of screwed connections at passage holes in mind)

b) Cutting hoses to size

– Measure the hose lengths in the vehicle; make sure there are no sharp bends/kinks (do not exceed the minimum bending radius).

NOTE

Minimum bending radius for clip connections and refrigerant hose GH134:
Bending radius refrigerant hose NW 10 (R min.: 65 mm)
Bending radius refrigerant hose NW 12 (R min.: 75 mm)

Minimum bending radius for clip connections and refrigerant hose FC802:
Bending radius refrigerant hose NW 10 (R min.: 77 mm)
Bending radius refrigerant hose NW 12 (R min.: 89 mm)

NOTE

When routing the hoses be sure to avoid narrow bends in vertical direction as refrigerator oil may collect in these bends. This may result in inadequate oil circulation and thus in damage to the compressor, even if the minimum bending radii of the hoses were observed.

– Cut the hoses at right-angles with hose shears or clamp the hose horizontally in a vice with profile protection jaws and saw it at right-angles using a steel saw with fine teeth.
– Remove residues of rubber and textile reinforcement linings.

c) Fit rubber pads on the cut-outs in the body (edge protectors or cable grommets).

d) Install the fittings

NOTE

Fit the hose lines with the following connections:

- Intake line: Refrigerant hose NW 12
  - 90° screwed connection with flange (on expansion valve)
  - 90° screwed connection (7/8") with filler neck (on compressor)
- Discharge line: Refrigerant hose NW10
  - 90° screwed connection (3/4") (on condenser)
  - 90° screwed connection ZSB (3/4") with filler neck (on compressor)

NOTE

If you ordered the installation kit for external hose installation, the straight connections in it as well as the 90° connections with filler necks from the standard installation kit must be used.

NOTE

As from August 2002, installation kits have been supplied with a clip system. In this case refer to the installation instructions in 4.8.2.
If you wish to replace the hoses, a refrigerant hose of type FC802 (fitted with a screw system) may also be affected. In this case refer to the installation instructions in 4.8.3.
See also: 6.7. Repair work

4.8.2 Install the clip system

– Remove anti-corrosive coatings from metal components (nipples and fitting) using a cleaning product (for example petroleum ether).
– Insert two clips of the appropriate size to the cut end of the hose (Fig. 4.4/1). The direction of the clips has no effect on the performance of the connection. To make the installation work easier, both clips should face in the same direction.

NOTE

If the clips are not fitted on to the hose at this point, they will have to be pulled on to the hose or fitting later and then opened. This may permanently damage the clip.

– Coat the nipple with plenty of refrigerant (Fig. 4.4/2). This **must** be done to reduce the force required to insert the nipple.
– Fit the nipple into the hose (Fig. 4.4/3). To ensure that the nipple has been fitted properly, check the gap between the end of the hose and the nipple collar. Do not kink or otherwise damage the hose as you fit the nipple. Remove any excess oil from the nipple and hose.
– Engage the bar in the nipple groove, leave the arms of the bar pointing in the same direction as the hose (Fig. 4.4/4). If the bar is correctly installed it can be rotated relative to the nipple. The bar ensures that the clips are positioned over the O-rings and that the connection will satisfy the pressure requirements.
– Position the clips over the arms of the bar in the ducts provided (Fig. 4.4/5).
– Close the clips with the clip pliers (Fig. 4.4/7). Hold the pliers at right-angles to the clip connection points as you do so (Fig. 4.4/6). They should also be at a right-angle when you close the clips. Position the jaws of the pliers under the raised section of the clip of the interlock. To make them easier to install, the clips should be closed between the arms of the bar.

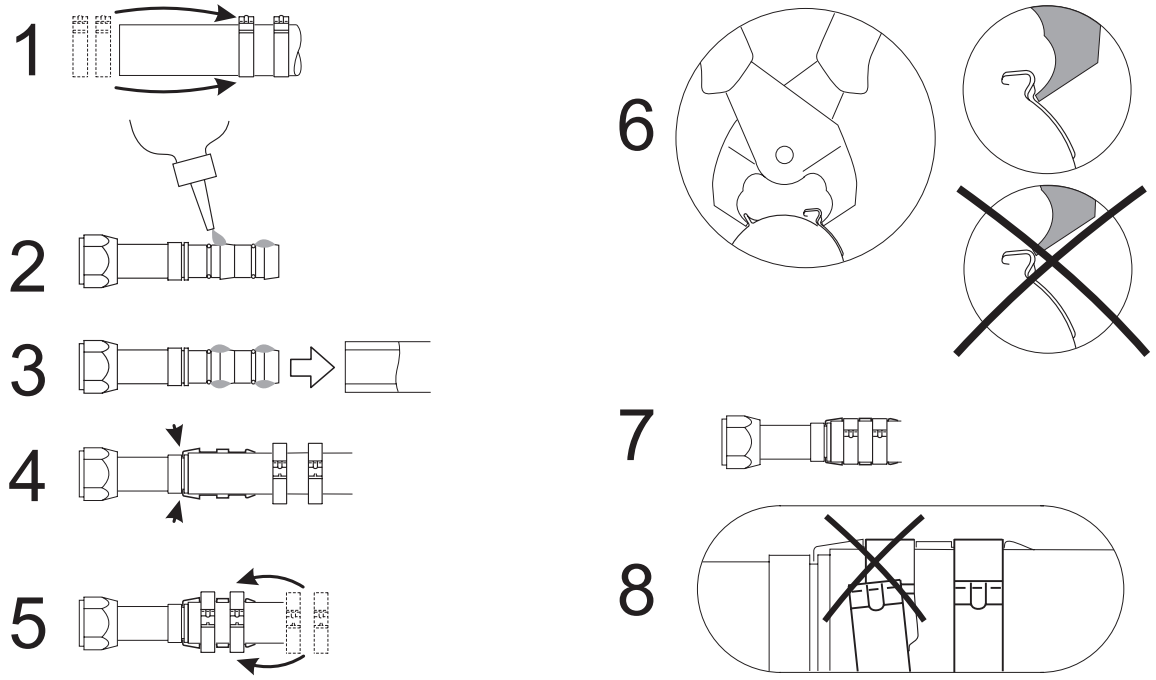


Fig. 4.4

NOTE

If you do not hold the pliers at right-angles to close the clips the clips' closure may be slightly out of position (Fig. 4.4/8). In this case correct the clip closure with the pliers.

NOTE

Clip components should not be reused.

- Ensure that the hose is in perfect condition; make sure there are no constrictions or bulges, particularly at the transition to the fitting.
- Blow out the hose lines with nitrogen or dried compressed air.
- Seal the hose lines and test them for leaks using nitrogen or dried compressed air by placing them in a water bath (test pressure approx. 35 bar) (Fig. 4.6).

WARNING

Only carry out this test with the appropriate safety equipment in place.

WARNING

If you fail to follow the installation instructions or use the refrigerant hoses with fittings other than those supplied with them, you may produce unreliable and unsafe connections, which may result in the sudden or accidental escape of refrigerant gas.

4.8.3 Install the screw system

- Remove anti-corrosive coatings from metal components (nipples and fitting) using a cleaning product (for example petroleum ether).
- Do not strip the hose. Clamp the threaded fitting in place and screw the hose into the socket as far as it will go by turning it anti-clockwise, then turn it back through a ¼ turn (Fig. 4.5).
- Apply refrigerator oil (PAG) to the hose inner tube and nipple thread (see figure).
- Holding nipple at the hexagon, screw it into the socket and the hose by turning it clockwise until there is a gap of approx. 1.0 to 1.5 mm between hexagon and socket. Do not tighten it (Fig. 4.5).
- Ensure that the hose is in perfect condition; make sure there are no constrictions or bulges, particularly at the transition to the fitting.
- Blow out the hose lines with nitrogen or dried compressed air.
- Seal the hose lines and test them for leaks using nitrogen or dried compressed air by placing them in a water bath (test pressure approx. 35 bar) (Fig. 4.6).

WARNING

Only carry out this test with the appropriate safety equipment in place.

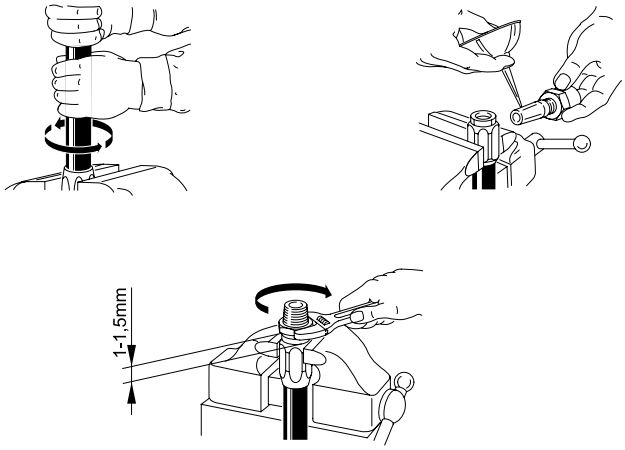


Fig. 4.5

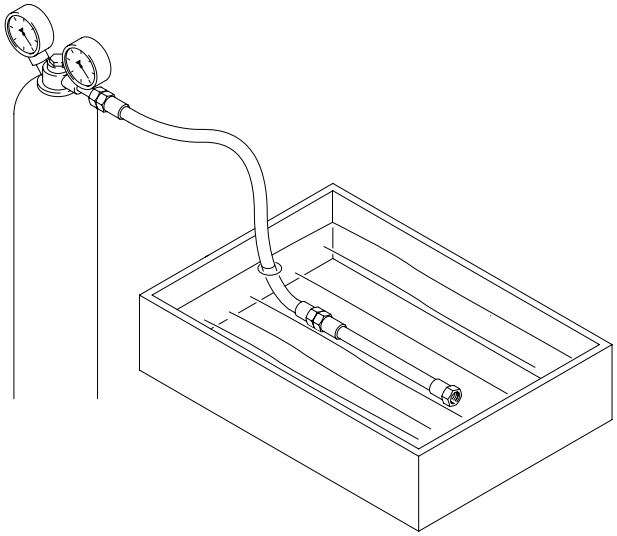


Fig. 4.6

4.9. Installation of roof-top air-conditioning unit with air distribution panel

Seal the aid duct

A weatherseal is to be produced using the supplied sealing strips (see Fig. 4.8) for curved roofs or roofs with beads and channels

Flat roofs or roofs without beads and channels can be sealed perfectly adequately with Sikaflex instead of a weatherseal

Preparing the weatherseal:

a) Cut out the weatherseal taking care to adapt its thickness to the contours of the roof (beads, channels and roof curvature), so that the contours (Fig. 4.7) are properly sealed. The thickness of the sealing material should be compressed by approx. 20 %-40 % when the air-conditioning unit is installed.

b) The height of the spacers may have to be adjusted so that the sealing strip is pressed on to the roof over its entire length. Prepare the spacers so that they also fit around any curves in the roof contour.

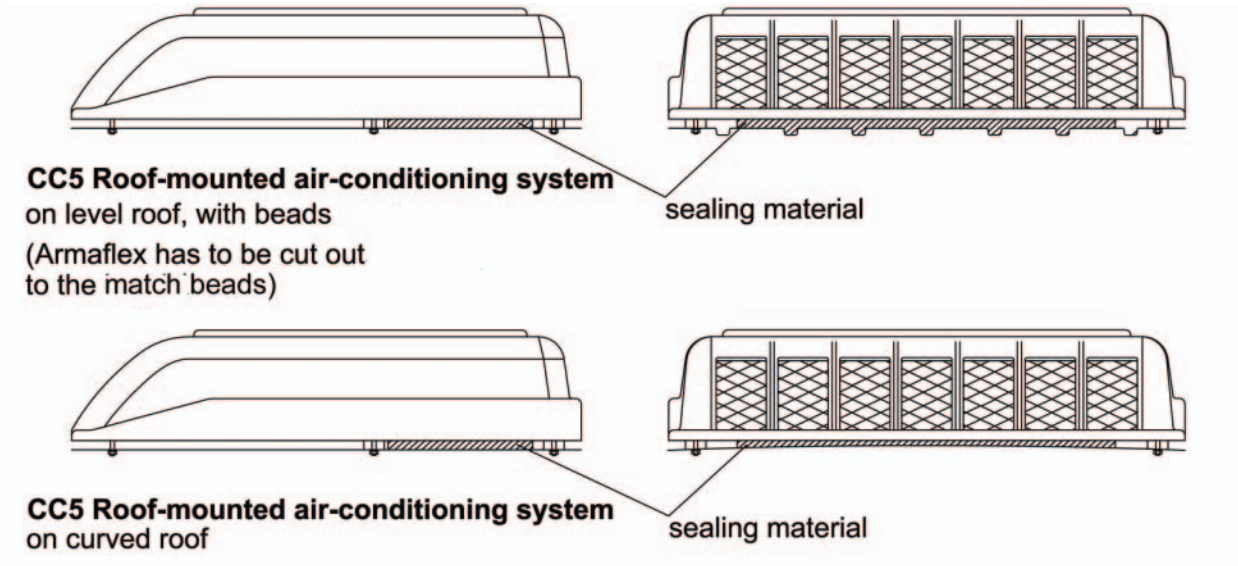


Fig. 4.7

c) Affix the sealing strip to the roof as shown in Fig. 4.8 using the Sikaflex 221 supplied in the installation kit.

d) Coat the top of the sealing strip with Sikaflex sealing compound.

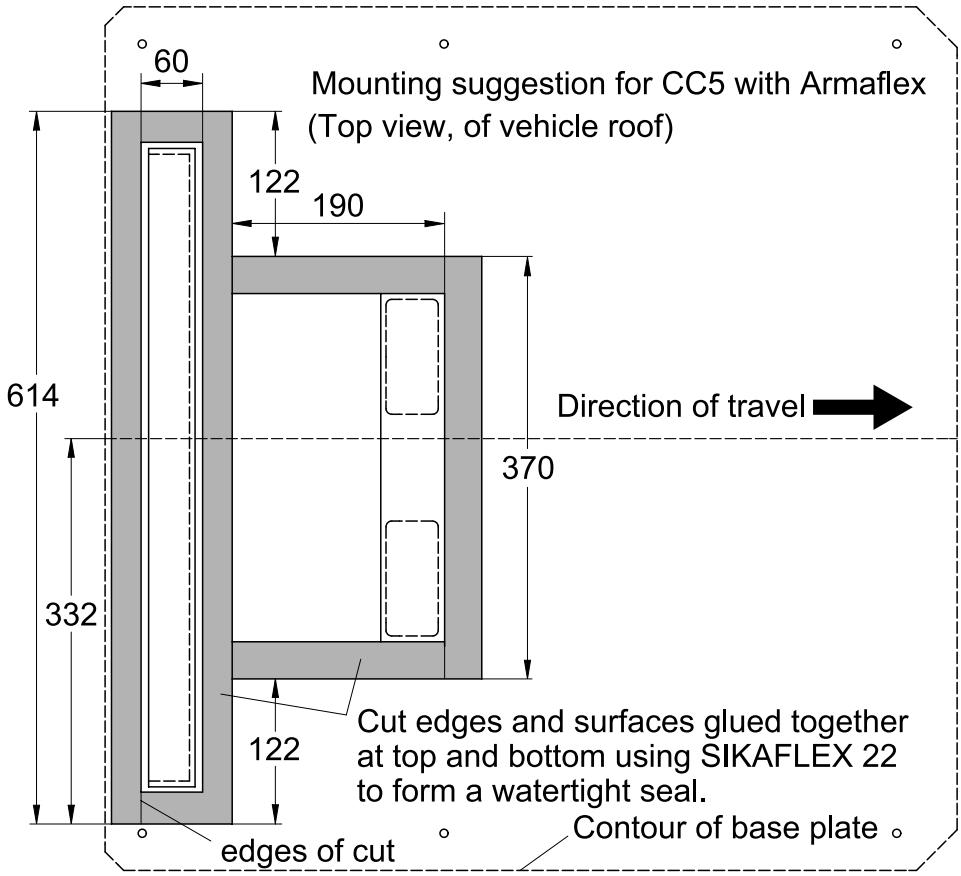


Fig. 4.8

NOTE

If Sikaflex 221 is used for the installation of the roof-top air-conditioning unit, it should be left to cure for 3-5. Install the base plate before Sikaflex has cured. Do not expose the seal to moisture until the Sikaflex has cured.

Install the base plate

a) Remove the cover from air-conditioning unit.

b) Position the base plate on the roof (weatherseal), align it, position spacer discs underneath the six fixing points and put the six M6 screws (with washers) through the holes (Fig. 4.9).

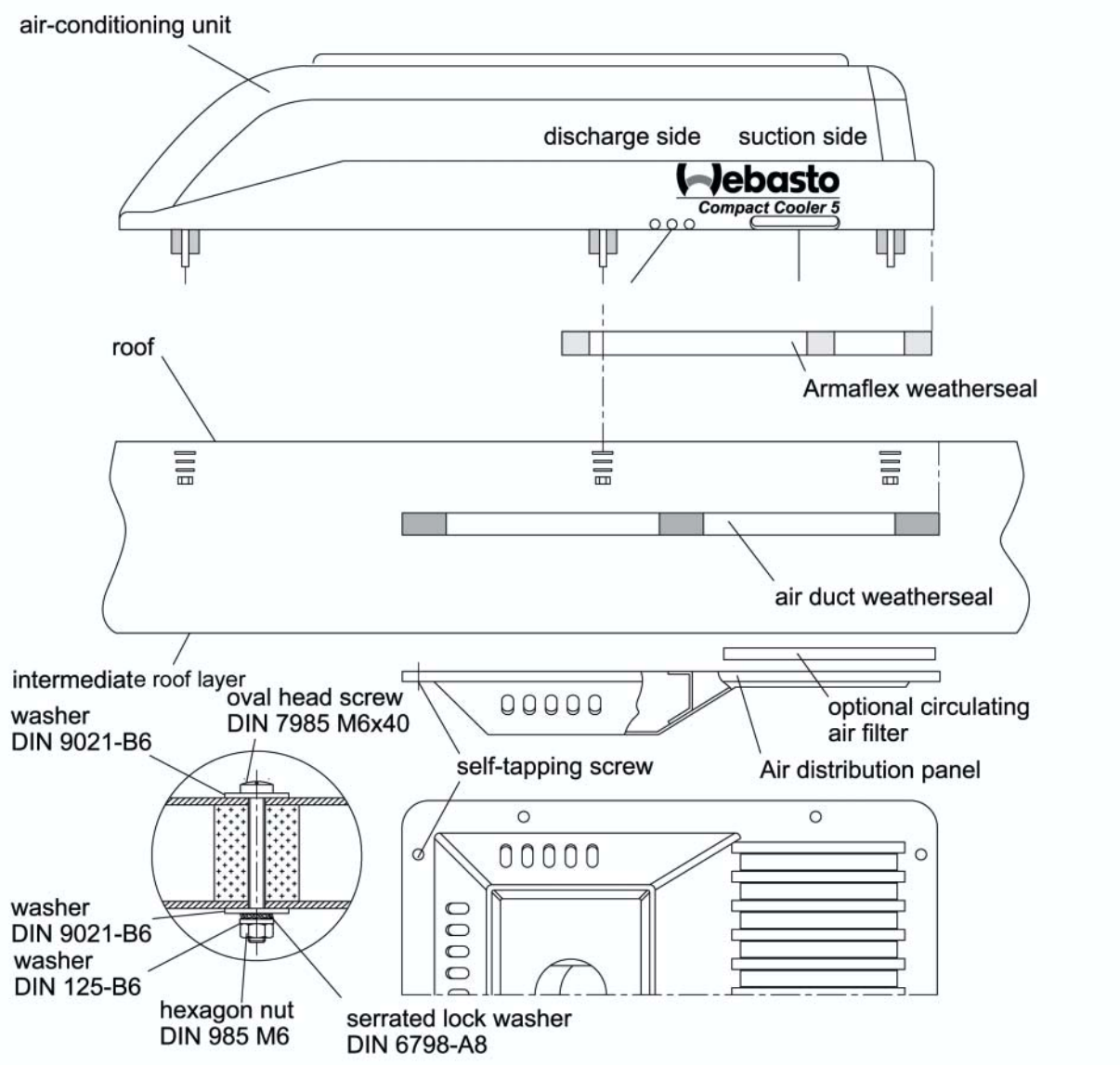


Fig. 4.9

c) Check that the base plate is in the correct position and secure it uniformly using the washers, fan-disk washers and nuts supplied in the installation kit (tightening torque 9 Nm).

CAUTION

Ensure that any moisture between the vehicle roof and the base plate can escape. When sealing the weatherseal make sure that the condensation drain holes at the sides and the rain water drain holes remain clear and unobstructed. This means that no additional seals may be used apart from the Sikaflex 221 and the Armaflex weatherseal.

Assemble the air distribution panel

Depending on the version and the components supplied, the rocker switches and, if applicable, the setpoint generator potentiometer may have to be installed in the air distribution panel.

Install the rocker switches

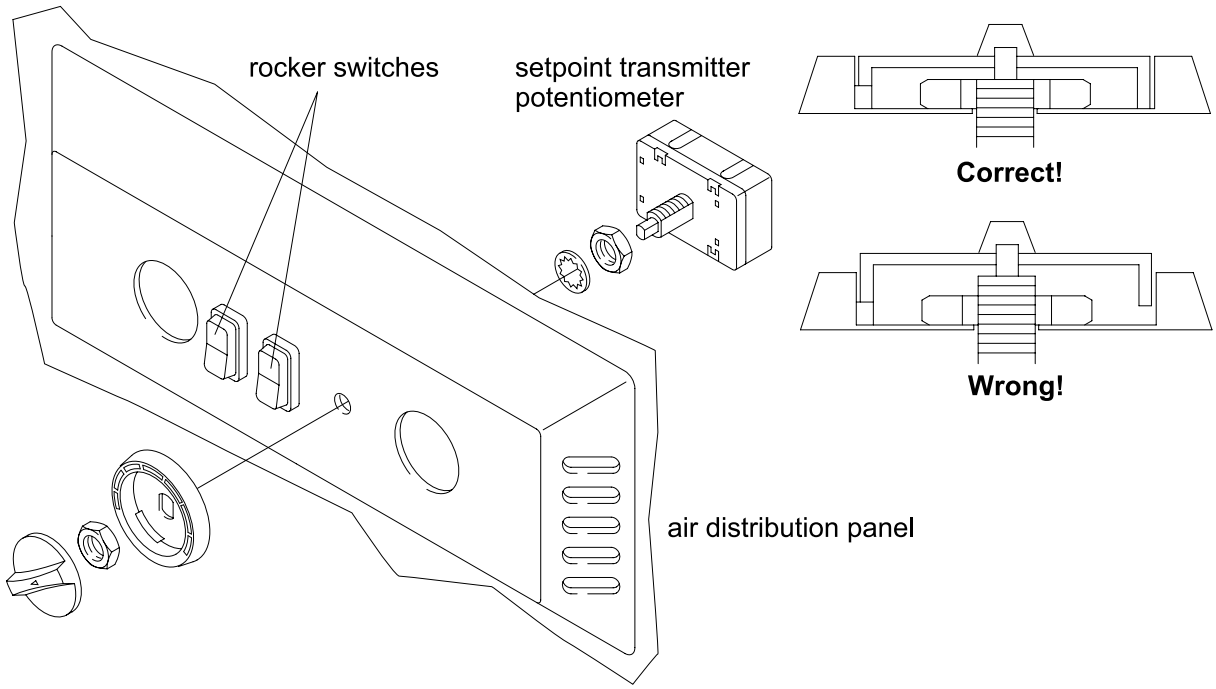


Fig. 4.10

Push the rocker switches into the rectangular cut-outs provided in the air distribution panel until they lock into place. (Fig. 4.10)

Install the setpoint generator potentiometer

Insert the setpoint generator potentiometer into the hole in air distribution panel as shown in Fig. 4.10.

The wiring harness is (mechanically) prepared for connection to the setpoint generator potentiometer. Simply pull on connector housing to unplug the connector. The connector housing can be locked (self-locking action) by simply pulling on the wiring harness.

NOTE

The fibre optic cable must be in contact with the rotary knob.

Install the air distribution panel

a) Prepare the air duct weatherseal (if necessary) in such a way that it securely seals the intake and discharge sections between the vehicle roof and the intermediate ceiling at the top and all sides.

b) Secure the air duct weatherseal to the roof. When drilling the required holes ensure that you do not damage the roof-top air-conditioning unit.

c) Make the cable connections between the air distribution panel (S1 and S4 in the circuit diagram, Fig. 3.1 or 3.2) and the base plate.

d) Position the air distribution panel as shown in Fig. 4.9 and secure to the intermediate ceiling or to suitable, self-made mounting brackets using ten self-tapping screws. If the optional circulating air filter has been ordered, it must be inserted in the intake area of the air distribution panel.

NOTE

The air distribution panel must not be aligned with the centre of the roof-top air-conditioning unit. The air distribution panel must cover the air intake opening in the vehicle roof.

4.10. Install the compressor

Before you install the refrigeration compressor in the vehicle, it must be filled with the correct amount of refrigerator oil in addition to its initial factory filling (see the technical data for the compressor). The amount of oil required depends on the length of hose used and is shown in the following table

.

	Hose lengths	**Additional amount of oil**
CC5 air-conditioning unit	6 m 11 m	+ 50 cc + 80 cc

The oil should be inserted either through the oil filler plug on the compressor or through the high pressure port.

NOTE

Refrigerator oil is highly hygroscopic and must therefore be exposed to air for as short a time as possible. The compressor and oil tank must therefore be resealed as quickly as possible.

Compressor installation:

a) Install the compressor with the bracket (see Chapter 4.7) on the engine (installation position as shown in Fig. 4.2).

b) Install and tension the V-belt.

c) Check the installation position.

WARNING

Keep hands, long hair and other objects well clear of all rotating parts.

d) Start the engine and check that the V-belt pulley runs smoothly.

4.11. Make electrical connections

NOTE

Protect the plug connections against moisture by treating them with a suitable wax.

a) Disconnect the vehicle battery.

CAUTION

- Follow the vehicle manufacturer's instructions for connecting the power supply for the air-conditioning system.
- Only use cables approved for use in motor vehicles with an adequate cross-section (see Fig. 3.1 and Fig. 3.2).
- Work on the electrical system may only be carried out by authorised personnel.
- Use rubber grommets for routing cables through sheet metal cut-outs.

b) Make the cable connections as shown in Fig. 3.1 or Fig. 3.2.

- Whenever possible, place cables in protective sheaths and secure them properly with cable ties.
- Thread the power supply cables (positive and negative) for the roof-top air-conditioning unit and the cable for connecting the compressor through the cable grommet in the system at the evaporator side panel (Fig. 2.2 item 26).
- Use strain-relief clamps.

NOTE

If the control elements are not to be installed in the air distribution panel, you may use the optional wiring harness for the external installation of the control elements to extend the electrical cables.

4.12. Prepare and install the refrigerant lines in the vehicle

CAUTION

The line openings must remain capped until immediately before their connection.

Follow the vehicle manufacturer's instructions for their installation.

a) Prepare both refrigerant hoses as described in Chapter 4.8.

b) If you ordered the installation kit for external hose installation, the two hose lines contained in this kit must be installed as set out below (Fig. 4.11).

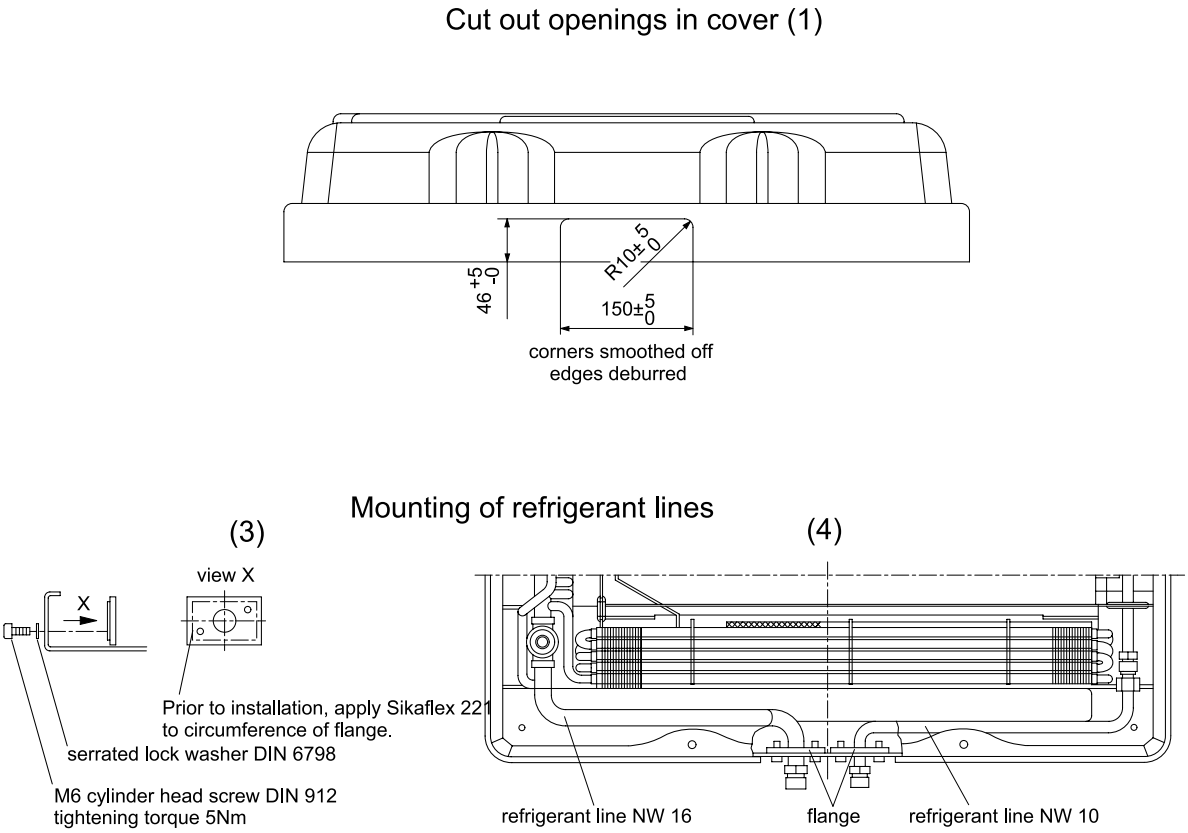


Fig. 4.11

- Open the cover.
- Cut out the openings in the cover shown in Fig. 4.10 (1), round off the corners and deburr the edges.
- Remove the cover from the refrigerant line cut-outs in the base plate.
- Using the supplied insulation tape, wrap the NW 16 hose from the threaded fitting up to the flange for the expansion valve.
- Remove the protective caps at the condenser and adhesive tape at the expansion valve. Remove protective caps from the refrigerant lines.
- Lubricate the O-rings from the installation kit with refrigerator oil and fit them to the pipelines.
- Coat the NW 16 and NW 10 pipelines on the flange plates with Sikaflex 221, see Fig. 4.11 (3)
- Working from the inside, insert the NW 16 pipeline into the cut-out in the base plate, connect it to the expansion valve outlet and secure it to the expansion valve using the M6 screw from the installation kit (tightening torque 5 Nm). See Fig. 4.11 (4).
- Working from the inside, insert the NW 10 pipeline into the cut-out in the base plate, connect it to the condenser inlet, and secure it with the union nut. Fig. 4.11 (4)
- Secure the pipelines to the base plate from the outside using the M6 cylinder head screws and fan-disk washers (tightening torque 5 Nm). See Fig. 4.11 (4).

c) Route the refrigerant hoses from the connection at the roof-top air-conditioning unit to the compressor and connect them. Observe the following as you do so:

- Wet the O-rings with refrigerator oil before fitting them.
- Route the hoses with no tension and not on sharp edges and secure them with clamps and cable ties for strain relief.
- Do not bend the hoses through angles below their minimum bending radii (see 4.8.1 for minimum bending radii).
- If you have not already done so, fit rubber grommets to the cut-outs and seal them with sealing compound, for example Sikaflex 221, if necessary.
- To reduce the formation of condensation, wrap the screw connection on the expansion valve in the insulation tape supplied in the installation kit.

4.13. Leak-test and evacuate the system

General notes

a) Moisture and air or other gaseous impurities in the refrigerant circuit cause malfunctions and may damage the air-conditioning system components. The system therefore must be thoroughly dried and evacuated (for at least 1.5 hours) before it is filled with refrigerant. This not only applies to newly installed air-conditioning systems, but also to systems that have been repaired if the refrigerant had to be discharged beforehand.

The final vacuum in the system must not exceed the absolute vacuum by more than 0.005 bar. Consequently the absolute pressure in the system must be $\leq$ 0.005 bar.

b) The absolute pressure indicated on the gauge depends on the ambient atmospheric air pressure. This must be taken into consideration.

c) Refrigerant can escape through the smallest leaks. The refrigeration circuit must therefore be completely sealed. To prevent any unnecessary refrigerant loss from occurring, we recommend that the system be inspected repeatedly for leaks during the evacuation process.

d) The quick-action stop valves are fixed to the fittings on the refrigerant hoses. The quick-action stop valves for the discharge and intake lines have different diameters so that the connections cannot be confused.

Description of the fittings

The test fittings consist of a intake pressure gauge, a high pressure gauge and a vacuum pressure gauge, as well as the four ports listed below, all of which can be shut off by means of a stop valve.

Connections/hoses:

LOW Connection for the intake side of the system

- Yellow hose with Low Side quick-action stop valve

HIGH Connection for the discharge side of the system

- Red hose with High Side quick-action stop valve

REF Connection for refrigerant bottles

- Yellow hose with quick-release screw coupling 7/16" UNF

VAC Connection for vacuum pump

- Yellow hose (thick) with quick-release screw coupling 5/8"

Evacuation

Switch on the vacuum pump and evacuate the system for at least 1.5 hours. The absolute pressure achieved must be at least 0.005 bar.

During the evacuation process with the pump running, repeatedly close all valves of the test equipment and check the pressure gauge readings. If there is no change in the vacuum reading over a period of one minute, you may assume that there are no leaks in the system. Re-open the valves after each pressure check.

A rise in the pressure indicates a leak in the system. In this case, stop the evacuation process and isolate and seal the leak. Then repeat the evacuation procedure.

a) Close all valves on the test equipment. Switch off the vacuum pump. Leave the system for at least one hour and then check the vacuum. If vacuum does not change, the system has been evacuated sufficiently and is not leaking.

4.14. Fill the system with refrigerant

General

The air-conditioning system must be filled with the correct amount of refrigerant for it. Therefore it is important to weigh the refrigerant bottle before starting the filling procedure and to check its weight continuously. The quantity of refrigerant depends on the length of the hoses (see table below).

	Hose lengths	**Volume of refrigerant R134a**
CC5 air-conditioning system	6 m	approx. 1.1 kg
	11 m	approx. 1.2 kg

The proper amount of refrigerant must also be checked by watching the inspection window (the refrigerant must contain no bubbles). The system will malfunction if it contains too much or too little refrigerant.

Pre-filling

NOTE

The pre-filling process is performed on the intake and discharge sides of the system.

a) The shut-off valve of the vacuum meter on the VAC test equipment must be closed since it would otherwise be destroyed.

b) Open the LOW, HIGH and REF shut-off valves.

c) Open the refrigerant bottle.

d) Allow refrigerant to flow into the system until the pressure in the bottle and that in the system have been equalised and the gauge readings no longer indicate any rise in pressure, or until the correct volume of refrigerant has been inserted. The resultant pressure depends on the refrigerant temperature.

e) Close all the valves on the test equipment and the bottle.

Leakage test

Use the leak detector to check all the potential sources of leaks in the system. Apart from the line connections, these include the refrigerant hoses themselves as well as the sealing surfaces on the compressor.

NOTE

Provided no leak is detected, the system can now be filled completely.

Final filling

CAUTION

If liquid refrigerant is topped up on the intake side (bottle upside down), the compressor will be destroyed by the hammering action of the liquid.

NOTE

The air-conditioning system can only be filled completely when the compressor is running. To prevent the compressor being damaged, the refrigerant may only be filled in gaseous form through the intake side of the system. The bottle must always be kept in a vertical position with the valve at the top. The higher the compressor speed, the shorter the time required for filling.

a) Fit the cover on to the air-conditioning unit.

b) Open the valve at the intake pressure gauge on the LOW test equipment. The high pressure valve remains closed.

c) Open the bottle valve and the REF filling valve.

d) Reconnect the vehicle battery and start the engine.

e) Set the air-conditioning system to cooling mode (fan speed 3) (see Chapter 5.3).

f) Check the weight of the refrigerant bottle and check the inspection window.

NOTE

The correct volume of refrigerant has been inserted into the system as soon as the refrigerant flows through the inspection with no bubbles with the engine at its high idling speed.

g) Close all valves on the test equipment. Switch off the air-conditioning system. Close the bottle valve, unscrew the compressor shut-off valves completely.

h) Switch off the vehicle’s engine.

4.15. Completion

a) Check the refrigerant pressures and the function of the pressure cut-out switches as described in 6.8.

b) Close all open covers on the vehicle/cab.

c) Have a qualified expert check that the installation work has been carried out properly.

5. START-UP

5.1. Safety notes

Observe the safety notes set out in Chapter 1.4.

5.2. Operator notes

CAUTION

Only start the air-conditioning system when the vehicle's engine is running as the vehicle battery will be discharged if the engine is at rest.

To prevent any deterioration of the sealing action of the shaft seal in the compressor, a distinction must be made between two different situations:

(1) If the vehicle is not used for an extended period, the compressor must not be started.

(2) However, if the vehicle is to be used for an extended period without making use of the air-conditioning system, we recommend that the compressor be started every two weeks. Otherwise the shaft seals might by damaged if the compressor is not used for a lengthy period.

NOTE

In keeping with the type of electrical connection (see Fig. 3.1), it should only be possible to switch on or operate the system when the vehicle's engine is running.

If the electrical connection of the air-conditioning system is such that the fans can be activated when the engine is switched off, they will not cool the cab. Operating the system with the engine switched off results in the air in the interior of the vehicle being circulated.

Please bear in mind that this will discharge the vehicle battery.

The air-conditioning system is only functional if it is filled with the amount of refrigerant and refrigerator oil specified in the service and installation manual. Only R134 may be used as the refrigerant.

5.3. Operating and control elements

The roof-top air-conditioning unit is controlled by two rocker switches in the air distribution panel (Fig. 5.1):

– Air-conditioning unit ON / OFF (1)
– 3-speed rocker switch (2)

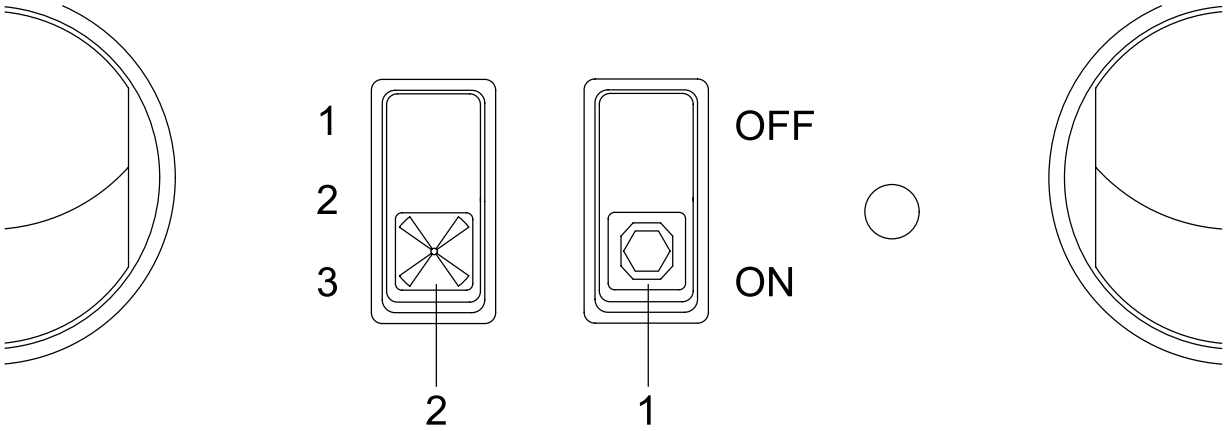


Fig. 5.1

5.4. Initial start-up

a) Start the engine following the manufacturer's instructions.

b) Switch on the system using the ON / OFF rocker switch.
Operate the system at the maximum fan speed setting (3-speed rocker switch at setting 3).
Cold air must be discharged from the air distribution panel after approx. 2 min.

c) Reduce the fan speed and check the air discharge rate.

5.5. Operation

NOTE

Refer to the operator notes.

Before you start the system, make sure that

- The air-conditioning system is in perfect condition,
- All routine maintenance work/checks have been carried out,
- The air inlets and outlets are clear (no leaves, etc.),
- The condensation drain holes are open.

Operation with the engine running

a) The system is operated by pressing the ON/OFF rocker switch and the fan switch.

b) When the engine is running, the vehicle interior is cooled in re-circulated air mode in accordance with the selected fan speed setting 1, 2 or 3.

c) The temperature of the CC5 air-conditioning system without an electronic thermostat is controlled by the de-icer thermostat in the system. This thermostat switches the compressor off once the evaporator reaches a temperature when ice is likely to form. The evaporator and condenser fans continue to blow. When the temperature rises above the trigger point of the de-icer thermostat, the compressor cuts in again.

d) The refrigeration capacity can be controlled manually by selecting different fan speed settings.

Speed 1: For minimum refrigeration capacity at a low discharge temperature and lowest fan speed

Speed 2: For medium refrigeration capacity at a medium discharge temperature and medium fan speed

Speed 3: For maximum refrigeration capacity at a somewhat higher discharge temperature and maximum fan speed

NOTE

To cool and dehumidify the interior of the vehicle after it has been parked for a lengthy period of time in a high ambient temperature and sunny conditions, we recommend that you initially operate the fan at speed 3. After the interior temperature has reached a pleasant level the fan can be turned down to speed 2 or 1 depending on the ambient temperature.

5.6. Operation of the air-conditioning system (deluxe version)

The operation of the system is identical to that of the basic version as described in Chapter 5.5.

On this version, however, a rotary dial can be used to select the required temperature using a setpoint generator switch. Once the preset temperature is reached, the compressor cuts out. If the temperature rises by approx. 2 °C, the compressor cuts in again.

6. MAINTENANCE

6.1. Safety notes

Observe the safety notes and regulations in Chapter 1.4.

6.2. General

a) All work on the refrigeration system must be carried out by trained personnel at authorised special service centres.

b) The special equipment, special tools and operational accessories listed in Chapter 4.5 are required and must be used for maintenance work on the refrigeration system.

c) As is the case with all parts of a vehicle, the air-conditioning unit is continuously subjected to a certain amount of stress and strain. To guarantee that the system operates correctly and to prevent any damage to the parts, the maintenance work must be carried out at regular intervals.

d) The proper treatment of the system and a record of all maintenance work are necessary for the acceptance of any warranty claims involving damage to parts that require regular maintenance.

e) During extended shutdown periods, the air-conditioning system must be operated at least once a month for a period of approx. 15 minutes so as to prevent the shaft seals on the refrigeration compressor from becoming drying out or any moving parts of the refrigeration circuit from seizing due to oil resinification. Prerequisite: (Minimum outside temperature 5 °C or within a heated shed)

NOTE

Always ensure that the amount of oil in the air-conditioning unit complies with the details in this installation and service manual. Total amount of oil = oil capacity of the compressor (Chapter 3.3) + amount of oil for the hose length (Chapter 4.10)

6.3. Maintenance and care

a) Irrespective of the schedule below, check all the attachments on the air-conditioning system and the connections on the refrigerant lines to ensure that they are tight within the first four weeks of using the roof-top air-conditioning system for the first time.

b) Even if the air-conditioning unit is not in use, individual components may be subject to wear due to the normal ageing process or the stresses or strains generated by driving the vehicle. The appropriate checks listed in the maintenance and service chart must therefore be carried out regardless of the time in which the system is in use.

c) Regardless of how long the system is in use, it is also possible to experience refrigerant loss despite the line connections being absolutely sealed. Owing to the material structure of the refrigerant hose lines they have a diffusion rate, the level of which may vary depending on the ambient temperatures. However, if relatively large quantities of refrigerant are lost over short periods of time, you may assume that there is a leak in the system.

d) If the condenser or evaporator fins become slightly soiled, they should be cleaned by directing compressed air against the normal direction in which the air flows.
If the soiling is severe or the unit has greasy deposits, first clean it using soap suds or a suitable cleaning solution (must be compatible with copper or aluminium) and then use compressed air or a jet of water.

e) The collector-drier must be replaced at least every twelve months. Always replace the collector-drier when carrying out work on the refrigerant system.

CAUTION

The refrigerant must never be vented into the open air (see § 8 CFC-Halon Prohibition Directive dated 06.05.91).

6.4. Maintenance and care checklist

System component	Maintenance work	Frequency		
		m	6 m	a
Refrigerant system				
– Hose lines	Check for chafing and the general condition		X	
– Connections	Conduct a leak test using a leak detector			X
– Refrigerant filling	Check refrigerant quantity through the inspection window	X		
– Condenser	Check the condition of the fins (clean if they are dirty)		X	
– Collector-drier	Replace			X
– Condensation drain	Check that the opening is clear and clean, if necessary		X	
– Roof-top air-conditioning unit	Check overall condition and check the connections are tight			X
Compressor				
– Electromagnetic clutch	Check non-slip engagement/start-up of compressor		X	
	Check that it operates silently		X	
– Compressor	Check that it is in perfect condition and properly tensioned			X
– V-belt	Check that it is in good condition and secure			X
– Fastening element				
Electrical connections				
– Connection cables	Check that they are in perfect condition		X	
– Plug connections	Check that they are in good condition and secure		X	

Key: m - monthly , a – annually (a – maintenance work to be carried out every six months if used all year round)

6.5. Inspections prior to repair

Prior to starting any repair work, check the overall condition of the air-conditioning system so as to avoid any unnecessary dismantling work and doing the same work twice.

Visual inspection

a) External condition of the roof-top air-conditioning unit

- The cover is not cracked and has no paint damage
- The air inlets and outlets are clean and undamaged
- Check that the mounting points are secure, no signs of corrosion
- Check that the hose and cable connections are in perfect condition
- Check that the sheet metal cut-outs are in perfect condition.

b) Check the condition of the hose lines

- No cuts, pinching, bulges, chafing
- Perfect clamps and quick-release couplings
- Check that the sheet metal cut-outs are in perfect condition.

c) Check the condition of the air distribution panel

- Check that the mounting points/screws are secure
- Check that the vent switch is in perfect condition
- Check that the re-circulated air inlet/outlet grille is undamaged and clean.

d) Check the condition of the compressor

- Check that the hose connections are undamaged and secure
- Check that the fastening elements/screws are secure

Check that the V-belt tension is perfect
Check that the V-belt and V-belt pulleys are undamaged
Check that the electromagnetic clutch and electrical connection are undamaged.

6.6. Troubleshooting

General

a) We recommend that you adopt a systematic approach to troubleshooting. Corrective action in the event of general malfunctions or deviations from setpoint values during pressure tests is to be carried out using the following procedures.

b) Some malfunctions can only be identified and rectified by trained personnel using special tools.

c) If the compressor is damaged (for example defective valve plates), it is imperative that the expansion valve be replaced since it is a possible cause of the malfunction.

Electrical troubleshooting

In this case the individual electrical circuits must be checked systematically using the circuit diagram (see Fig. 3.1), so that the fault can be identified. Ideally the plug connections, switches, relays, etc. must be checked for continuity.

The following potential sources of malfunctions should always be checked so that they can then be excluded as the cause of the particular fault:

- Defective fuses
- Corroded plug contacts
- Loose plug contacts
- Poor crimp contacts on plugs
- Corroded cables and fuses
- Corroded battery terminals

Air-conditioning system troubleshooting

- Defective evaporator or condenser fan
- Soiled or blocked air filter, condenser or evaporator fins
- Refrigerant loss or lack of refrigerant in the system

If the air-conditioner cuts out continuously, we recommend that you have the system checked by an authorised service centre.

Refrigerant system troubleshooting

If malfunctions occur in the refrigerant system, it must be checked by an authorised service centre and repaired properly. Under no circumstances must the refrigerant be vented into the open air. (§ 8, CFC-Halon Prohibition Directive dated 06.05.91)

Corrective action if the setpoint values cannot be reached during the pressure test

If the setpoint values cannot be achieved during the pressure test (Chapter 6.8), this may be due to the following causes. Check these causes, localise the malfunctions and repair or replace any defective parts.

Pressure at high pressure gauge too high

- Air flow rate at the condenser too low
- Excessive refrigerant
- Filter drier clogged

Pressure at high pressure gauge too low

– Lack of refrigerant (check inspection window)
– Compressor speed too low (due, for example the V-belt slipping)
– Compressor defective

Pressure at low pressure gauge too high

– Expansion valve defective
– Compressor speed too low (due, for example the V-belt slipping)
– Compressor defective

Pressure at low pressure gauge too low

– Throttle in the intake or discharge line, due, for example to kinks
– Expansion valve defective
– Lack of refrigerant (check inspection window)
– Air flow at evaporator too low

6.7. Repair work

CAUTION

Refrigerant must never be discharged into the open air
(see § 8 CFC-Halon Prohibition Directive dated 06.05.91).

NOTE

Observe the safety notes and provisions in Chapter 1.4 and guidelines in Chapter 6.2.

Always use genuine replacement parts for repair work and restore the unit to its original state.

a) When repairing the unit, use only genuine replacement or standard.
As from August 2002, installation kits for the hose connections have been supplied with a clip system. The GH-134 hoses and fittings for this system are not interchangeable with the screw system (FC802 hoses) used previously.
The following therefore applies to systems with this screw system when they require repairs:

– For replacing a refrigerant hose (type FC802):
The FC802 hose must be replaced with a new GH-134 hose.
You must also order the appropriate fittings from the clip range. The appropriate parts are set out in our spare parts list.
– For replacing a screw fitting (fitted with a FC802 hose):
You can still order the screw fittings. The appropriate part numbers are set out in our spare parts list.
After removing a fitting, check the hose for signs of damage. If you find any signs of damage, the hose must be replaced.

b) The aim of repair work is to restore the system to its original state.

CAUTION

Refrigerant must never be discharged into the open air
(see § 8 CFC-Halon Prohibition Directive dated 06.05.91).

WARNING

Observe the safety notes relating to handling refrigerants
(see Chapter 1.4).

c) Before you open or dismantle parts from the refrigerant system, the refrigerant must be placed in the recycling bottle provided for it and disposed of or reused in accordance with the relevant regulations.

d) When you have completed the work on the refrigerant system, the system must be

- evacuated as described in Chapter 4.13,
- filled with refrigerant as described in Chapter 4.14
- tested as described in Chapter 6.8.

6.8. Post-repair procedures and testing

Check the refrigerant pressures and function of pressure cut-out switches

e) General

Every air-conditioning system filled with a refrigerant is highly pressurised. This pressure is the same throughout the system and depends on the ambient temperature.

When the plant is operating, the pressure differs on the intake side and discharge side of the compressor. The pressures differ and are governed by the compressor speed, the temperature inside the vehicle, the ambient temperature and the relative humidity. Operating pressures that deviate from the norm indicate that the system is suffering a malfunction.

The operating pressures should be checked at a compressor speed of approx. 3000 rpm and at air temperatures of 20 °C up to a maximum of 40 °C. When you do so the fan must be set to speed 3. The cover must be fitted to test the pressure and to test the pressure controls since the air supply to the heat exchanger has a major influence on achieving the operating pressures.

The following values must be found:

External temperature	Low pressure gauge	High pressure gauge
25 °C	2.0 bar abs ± 0.2 bar	14 bar abs ± 2 bar
30 °C	2.1 bar abs ± 0.2 bar	16 bar abs ± 2 bar
35 °C	2.3 bar abs ± 0.2 bar	18 bar abs ± 2 bar
40 °C	2.7 bar abs ± 0.2 bar	22 bar abs ± 2 bar

If the pressure readings differ from the above values, have a specialised service centre check the causes of the difference.

After completing the pressure test, disconnect the test pressure gauges and screw on the sealing caps.

f) Check the high pressure control

- Connect the test equipment to the system.
- Remove fuse F3 (condenser fan) and fit the cover.
- Run the engine at medium speed and switch on the air conditioning system.
- Check that the compressor cuts out at a pressure of 26.5 ± 2 bar abs.
- Remove the cover and reinstall fuse F3 (condenser fan).
- Check that the compressor cuts in again when the pressure falls to 20± 2 bar abs.

g) Complete all the final work.

CAUTION

If the high pressure cut-out switch malfunctions the air-conditioning system must be switched off immediately because the refrigerant will be discharged through the safety valve when the pressure reaches a level of 34.5 bar abs.

Topping up refrigerant in partially filled systems

a) General notes

Generally no refrigerant is actually used. Refrigerant may only be lost due to leaks that may developed whilst the system is operating.

If the air-conditioning system does not contain sufficient refrigerant its cooling capacity will drop. If the refrigerant loss is considerable, the low-pressure cut-out switch will trip.

An inspection window is fitted in the system on the collector-drier so that you can check the refrigerant level. If the system contains the correct amount of refrigerant, it will flow past the inspection window without no bubbles around five minutes after the air-conditioning system has been switched on with the engine at its high idling speed. Isolated bubbles are not important. Only if foaming occurs must the system be topped up with refrigerant.

As a rule, refrigerant is added in its gaseous state. If the refrigerant has been completely discharged, the system must be properly evacuated before it is filled with refrigerant.

The cover must be fitted to top up the system since the air supply to the heat exchanger has a major influence on achieving the operating pressures in the refrigerant system.

b) Topping up with refrigerant

Refrigerant in gaseous form can only be added whilst the compressor is running and only to the intake side of the system.

The refrigerant bottle must be upright with the valve at the top for topping up the system with refrigerant in vapour form. Top up the system through the test equipment as described in Chapter 4.14.

6.9. Visual inspection

After completing all repairs, conduct a visual inspection as described in Chapter 6.5.

7. WARRANTY CLAIMS

a) The warranty does not cover parts that are subject to normal wear, or improper handling. The repair or replacement of the unit or parts thereof will not result in an extension of the warranty period.

b) In the event you wish to make a claim under the warranty, contact the agent in your country presenting the following

- Part covered by the warranty
- The warranty card
- The warranty claim.