

Repair Manuals

General information: Air conditioning

Basic operating principles

Air conditioning system:

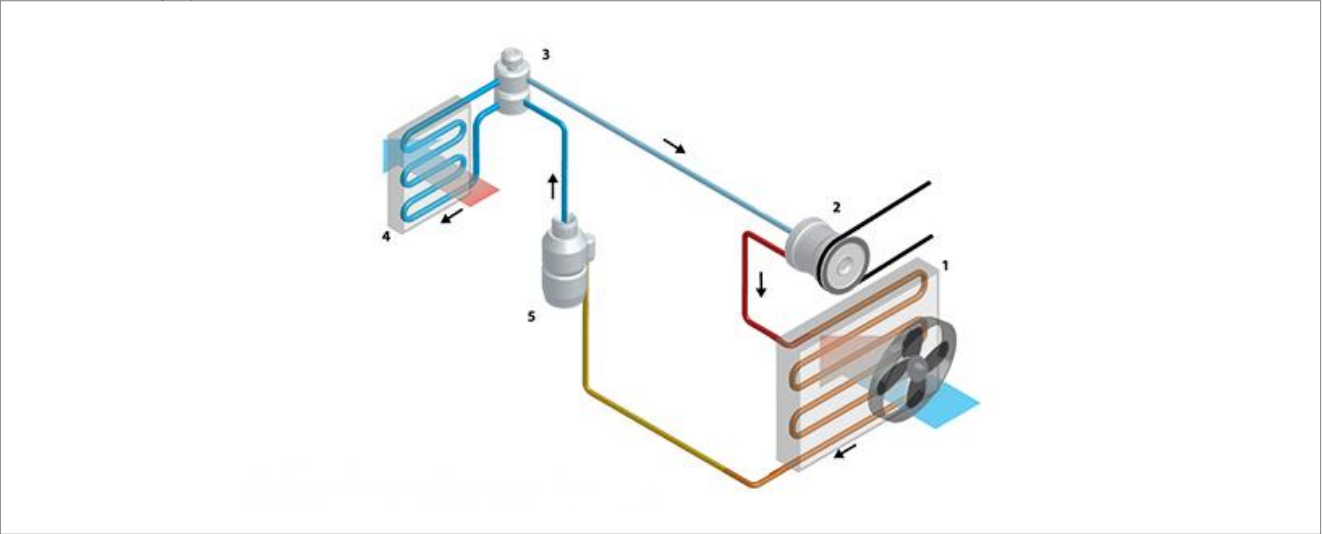


Image call-out

- 1. Air-conditioning condenser
- 1. Air-conditioning compressor
- 1. Expansion valve
- 1. Air-conditioning evaporator
- 1. Air-conditioning dryer

Air conditioning system low-pressure side

The low-pressure side produces the cooling effect. The liquid flows from the expansion valve through the evaporator, returning as a vapour.

Air-conditioning system high-pressure side

The vapour from the expansion valve passes to the compressor. The vapour is compressed, generating a heated liquid. The liquid then passes to the condenser, where it is cooled.

Air-conditioning compressor

The air conditioning compressor circulates the refrigerant under pressure. The low-pressure gas is changed to a high-pressure gas.

Air-conditioning condenser

The air-conditioning condenser is a heat-exchanging device. The condenser changes the high-temperature gas from the compressor into a high-temperature liquid.

Air-conditioning dryer

The air-conditioning dryer removes air bubbles and contaminants from the refrigerant. The air-conditioning dryer protects the system from contamination.

Air-conditioning evaporator

The evaporator is similar to the condenser. A large surface of the evaporator operates as a heat exchanger, similar to a radiator.

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Expansion valve

The expansion valve regulates the liquid refrigerant flow into the evaporator. Due to expansion, the refrigerant changes from liquid to vapour. The evaporation process requires a lot of heat. The heat is absorbed from the vehicle's interior. Any refrigerant which bypasses the evaporator will flow back to the compressor.

R1234yf

R1234yf refrigerant has been used since 2011. Most vehicles still use R134a refrigerant.

Note: Never mix the two refrigerants

Caution! R1234yf refrigerant is flammable

Warning

Within the European Community, the use of R12 for service/repair became illegal on 31/12/2000. R12 (Freon) is a CFC (Chlorofluorocarbon) which is harmful to the ozone layer. An R12 system can be refilled with R134a. Note: Never mix the two refrigerants. An R134a system uses a different lubricant. R134a will contaminate the oil used in R12 systems. Refilling an R12 system with R134a will result in poor compressor lubrication.

Proceed as follows:

- Check that the manufacturer supports the conversion
- When converting an R12 system to R134a, drain the existing oil
- Flush the system completely before refilling it with R134a
- Fit a dryer which is compatible with R134a
- Fit a filler plug with an R134a service port
- Attach a label with the new refrigerant information
- The refrigerant quantity will be different if R134a is used
- Note the new refrigerant quantity required
- Renew the O-rings
- Renew the hoses

Diagnostics

Normally pressurised system	R12	R12	R12	R134a	R134a
	Kg / cm	PSI	Bar	PSI	Bar
Air conditioning system low-pressure side	1.5 - 2.0	21.3 – 28.4	1.47 – 1.96	21.3 – 35.5	1.47 – 2.45
Air-conditioning system high-pressure side	14.5 - 15.0	206 - 213	14.21 - 14.71	200 – 227	13.72 – 15.7

Undercharged system	R12	R12	R12	R134a	R134a
	Kg / cm	PSI	Bar	PSI	Bar
Air conditioning system low-pressure side	0.8	11.4	0.78	7.11 – 14.2	0.49 – 0.98
Air-conditioning system high-pressure side	8 – 9	114 – 127	7.84 – 8.82	100 – 142	6.86 – 9.8

Conditions:

- Low- and high-pressure sides - low pressure values are shown
- Bubbles are visible in the sight glass
- The output air is cool, not cold

Possible causes:

- Insufficient refrigerant in the system

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- Leaks in the system

Proceed as follows:

- Use a gas leak detector to check for leakage
- Repair if necessary
- Renew the refrigerant with the correct type

Overcharged system or faulty condenser cooling operation	R12	R12	R12	R134a	R134a
	Kg / cm	PSI	Bar	PSI	Bar
Air conditioning system low-pressure side	2.5	35.5	2.44	35.6 – 49.7	2.45 – 3.42
Air-conditioning system high-pressure side	20	284	19.58	285 – 355	19.65 – 24.47

Conditions:

- Low- and high-pressure sides - high pressure values are shown
- No bubbles are visible in the sight glass when the engine speed is decreased

Possible causes:

- Overcharged system or faulty condenser cooling operation
- Faulty condenser fan operation

Proceed as follows:

- Adjust the refrigerant quantity
- Clean the condenser
- Check the operation of the condenser fan

Air in the system	R12	R12	R12	R134a	R134a
	Kg / cm	PSI	Bar	PSI	Bar
Air conditioning system low-pressure side	2.5	35.6	2.45	35.6 – 42.6	2.45 – 2.94
Air-conditioning system high-pressure side	23	327	22.5	285 - 355	19.6 – 24.4

Conditions:

- Low- and high-pressure sides - high pressure values are shown
- The low-pressure side tubing is not cold to the touch
- Bubbles are visible in the sight glass

Possible cause:

- Air in the system

Proceed as follows:

- Renew the air-conditioning dryer
- Check the air-conditioning compressor parameters
- Check the air-conditioning compressor oil
- Renew the refrigerant with the correct type

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Faulty expansion valve; continuously open or incorrectly attached heat-sensitive tube	R12	R12	R12	R134a	R134a
	Kg / cm	PSI	Bar	PSI	Bar
Air conditioning system low-pressure side	2.5	35.5	2.4	42.7 – 56.8	2.9 – 3.9
Air-conditioning system high-pressure side	19 – 20	271 – 284	18.6 – 19.5	285 – 355	19.6 – 24.4

Conditions:

- Low- and high-pressure sides - high pressure values are shown
- Extensive frost/moisture on the low-pressure side tubing

Possible causes:

- Faulty expansion valve; continuously open or incorrectly attached heat-sensitive tube
- Poorly regulated refrigerant flow

Proceed as follows:

- Check that the heat-sensitive tube is properly attached
- Check the expansion valve; renew if necessary

Moisture in the system	R12	R12	R12	R134a	R134a
		PSI	Bar	PSI	Bar
Air conditioning system low-pressure side	50 cm Hg	9.6	0.66	Vacuum	Vacuum
Air-conditioning system high-pressure side	7 Kg / cm ²	99.56	6.86	99.56 – 142	6.86 – 9.7

Conditions:

- Low-pressure side - the pressure reading fluctuates between normal and negative values

Possible causes:

- The expansion valve freezes and temporarily shuts off the refrigeration cycle

Proceed as follows:

- Check the expansion valve; renew if necessary
- Renew the air-conditioning dryer
- Renew the refrigerant with the correct type

Refrigerant not cycling	R12	R12	R12	R134a	R134a
		PSI	Bar	PSI	Bar
Air conditioning system low-pressure side	76 cmHg	14.7	1.0	Vacuum	Vacuum
Air-conditioning system high-pressure side		85.3	5.8	71.2 – 85.3	4.9 – 5.8

Conditions:

- Low-pressure side - negative pressure values are shown
- High-pressure side - extremely low pressure values are shown
- Frost between the dryer and the expansion valve

Possible causes:

- Dust particles or water droplets stuck or frozen inside the expansion valve
- Gas leakage around the heat-sensitive tube

Proceed as follows:

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- Check the expansion valve; renew if necessary
- Renew the air-conditioning dryer
- Renew the refrigerant with the correct type
- If the heat-sensitive tube is faulty, renew the expansion valve

Insufficient compression	R12	R12	R12	R134a	R134a
	Kg / cm	PSI	Bar	PSI	Bar
Air conditioning system low-pressure side	4 – 6	56.9 – 85.3	3.9 – 5.8	56.9 – 85.3	3.9 – 5.8
Air-conditioning system high-pressure side	7 – 10	100 – 142	6.8 – 9.8	100 – 142	6.8 – 9.8

Conditions:

- High-pressure side - low pressure values are shown
- Low-pressure side - high pressure values are shown

Possible causes:

- Internal leakage in the compressor

Proceed as follows:

- Check the air-conditioning compressor parameters
- Renew if necessary

Pressure charts

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Engine speed (rpm):	Relative humidity	Ambient air temperature	Discharge air approximate temperature	Low-pressure gauge	Low-pressure gauge	High-pressure gauge	High-pressure gauge
	%	°C	°C	Bar	PSI	Bar	PSI
1500	20 - 25	21.1	6.1	0.76	11	12.20	177
1500	20 - 25	26.8	8.9	1.03	15	14.33	208
1500	20 - 25	32.2	12.8	1.38	20	15.71	228
1500	20 - 25	37.8	17.2	1.58	23	17.57	255
1500	30 - 35	21.1	7.2	0.83	12	12.47	181
1500	30 - 35	26.8	10.6	1.10	16	14.74	214
1500	30 - 35	32.2	15.0	1.52	22	16.12	234
1500	30 - 35	37.8	19.4	1.79	26	18.40	267
1500	40 - 45	21.1	8.3	0.90	13	12.75	185
1500	40 - 45	26.8	12.2	1.24	18	15.15	220
1500	40 - 45	32.2	16.6	1.65	24	16.74	243
1500	40 - 45	37.8	22.2	2.00	29	19.15	278
1500	50 - 55	21.1	9.4	0.96	14	13.02	189
1500	50 - 55	26.8	13.9	1.30	19	15.57	226
1500	50 - 55	32.2	18.9	1.79	26	17.29	251
1500	50 - 55	37.8	25.0	2.20	32	19.91	289
1500	60 - 65	21.1	10.6	1.03	15	13.30	193
1500	60 - 65	26.8	16.5	1.45	21	16.05	233
1500	60 - 65	32.2	21.0	1.93	28	17.85	259
1500	60 - 65	37.8	27.9	2.41	35	20.67	300
1500	70 - 75	21.1	12.5	1.10	16	13.64	198
1500	70 - 75	26.8	17.2	1.52	22	16.40	238
1500	70 - 75	32.2	22.9	2.07	30	18.40	267
1500	70 - 75	37.8	31.1	2.55	37	21.50	312
1500	80 - 85	21.1	12.8	1.24	18	13.92	202
1500	80 - 85	26.8	18.3	1.65	24	16.81	244
1500	80 - 85	32.2	25.0	2.20	32	19.08	277
1500	80 - 85	37.8	32.2	2.69	39	21.77	316
1500	90 - 95	21.1	14.4	1.30	19	14.19	206
1500	90 - 95	26.8	20.0	1.72	25	17.23	250
1500	90 - 95	32.2	27.3	2.34	34	19.57	284
1500	90 - 95	37.8	35.0	2.82	41	22.17	321