# Contents

**00 - Technical data** . . . . . 1

**1 Safety information** . . . . . 1
1.1 Safety precautions when working on air conditioning systems . . . . . 1
1.2 Safety precautions when working on high-voltage system . . . . . 2
1.3 Safety precautions when working in the vicinity of high-voltage components . . . . . 2
1.4 Safety precautions when tow-starting or towing . . . . . 3

**2 Repair instructions** . . . . . 4
2.1 Rules for cleanliness when working on high-voltage system . . . . . 4

**3 General information on air conditioning** . . . . . 5
3.1 Other reference material . . . . . 5
3.2 Basics of air conditioning technology . . . . . 5
3.3 Vapour pressure table for refrigerant R134a . . . . . 7
3.4 Refrigerant R134a . . . . . 8
3.5 Properties of refrigerant R134a . . . . . 9
3.6 Refrigerant oil . . . . . 11
3.7 Comfort . . . . . 12
3.8 How air conditioning works . . . . . 13
3.9 General work safety . . . . . 13
3.10 Safety measures when working on vehicles with air conditioning and when working with refrigerant R134a . . . . . 16
3.11 Basics for working on refrigerant circuit . . . . . 17

**4 General information on refrigerant circuit** . . . . . 20
4.1 Components of refrigerant circuit . . . . . 20
4.2 Design of refrigerant circuit . . . . . 31
4.3 Evacuation and charging valves for quick-release couplings of air conditioner service station on refrigerant circuit . . . . . 32
4.4 Switches and senders in refrigerant circuit and related connections . . . . . 34
4.5 Electrical components not installed in refrigerant circuit . . . . . 39
4.6 Pressures and temperatures in refrigerant circuit . . . . . 42
4.7 Refrigerant circuit with expansion valve . . . . . 42
4.8 Refrigerant circuit with restrictor and reservoir . . . . . 44
4.9 Test and measurement work that can be performed using a pressure gauge . . . . . 46
4.10 Air conditioner service and recycling equipment . . . . . 47
4.11 Notes to repairs on refrigerant circuit . . . . . 48

**5 Laws and regulations** . . . . . 49
5.1 Laws and regulations . . . . . 49
5.2 Recycling and refuse law . . . . . 54
5.3 Converting R12 refrigerant circuits to R134a refrigerant circuits and repairing them (retrofitting) . . . . . 55
5.4 Maintaining records on refrigerant . . . . . 55

**6 Refrigerant circuit** . . . . . 56
6.1 Important repair notes on air conditioning . . . . . 56
6.2 Converting refrigerant circuits from R12 refrigerant to R134a . . . . . 56

**7 Working with the air conditioner service station** . . . . . 57
7.1 Important instructions for working with the air conditioner service station . . . . . 57
7.2 Connecting a air conditioner service station for measuring and testing . . . . . 58
7.3 Drain the refrigerant circuit using the air conditioner service station. . . . . 59
7.4 Evacuating refrigerant circuit using air conditioner service station . . . . . 59
7.5 Filling refrigerant circuit with air conditioner service station. . . . . 61
7.6 Bringing air conditioning system into service after charging . . . . . 62
7.7 Charging the container in the air conditioning service station with refrigerant . . . . . 62
7.8 Emptying air conditioner service station . . . . . 63

**8 Detecting leaks in refrigerant circuit ..... 64**
8.1 Leak detection in refrigerant circuit using compressed air or nitrogen ..... 65
8.2 Searching for leaks in refrigerant circuits using leak detector V.A.G 1796 ..... 66
8.3 Detecting leaks in refrigerant circuit using leak detecting system VAS 6196 or leak detecting system VAS 6201 or a later model ..... 67
**9 Clearing refrigerant circuit of contaminants ..... 75**
9.1 Vehicles with high-voltage system (hybrid vehicles) ..... 75
9.2 Blowing through refrigerant circuit with compressed air and nitrogen ..... 76
9.3 Flushing refrigerant circuit with refrigerant R134a ..... 78
**10 Clearing refrigerant circuit of contaminants, commercial vehicles ..... 110**
10.1 Vehicles with high-voltage system ..... 110
10.2 Flushing refrigerant circuit with refrigerant R134a ..... 111
10.3 Adapters for setting up flushing circuits ..... 111
10.4 Procedure for setting up and flushing refrigerant circuit, Amarok 2010 ► ..... 115
10.5 Procedure for setting up and flushing refrigerant circuit, Caddy 2004 ► ..... 121
10.6 Procedure for setting up and flushing refrigerant circuit, Crafter ►2017 ..... 128
10.7 Procedure for setting up and flushing refrigerant circuit, Crafter 2017 ► or MAN TGE ►, Crafter Grand California ► ..... 145
10.8 Procedure for setting up and flushing refrigerant circuit, Transporter 2016 ►, Transporter 2020 ► ..... 162
**11 Complaints ..... 178**
11.1 Possible complaints about refrigerant circuit ..... 178
11.2 Odours from heater and air conditioning unit ..... 179
**12 Connecting the air conditioning service station ..... 182**
12.1 For vehicles that have connections on both low-pressure and high-pressure sides of refrigerant circuit ..... 182
**13 Checking pressures on vehicles ..... 183**
13.1 Checking pressures in the refrigerant circuit (using a air conditioning service station) ..... 183
13.2 Checking systems with a restrictor and collector (with internally regulated air conditioner compressor) ..... 187
13.3 Checking systems with an expansion valve and reservoir (with internally regulated air conditioner compressor) ..... 191
13.4 Checking systems with an expansion valve and reservoir (without regulated air conditioner compressor) ..... 196
13.5 Checking systems with a restrictor and reservoir and air conditioner compressor regulating valve N280 (with externally regulated air conditioner compressor) ..... 197
13.6 Checking systems with an expansion valve, receiver and air conditioner compressor regulating valve N280 (with externally regulated air conditioner compressor) ..... 202
13.7 With expansion valve, receiver and electrical air conditioner compressor ..... 213
**14 Renewing components ..... 214**
14.1 In the event of leaking or damaged components (apart from the air conditioner compressor, receiver or reservoir) ..... 215
14.2 Renew the air conditioner compressor ..... 217
14.3 Replace receiver or reservoir and restrictor ..... 219
**15 Testing equipment and tools ..... 222**
15.1 List of test equipment, tools and materials ..... 222