Automotive Air-conditioning and Climate Control Systems

Steven Daly
BEng, BA (Hons), IEng, Cert Ed, MIMI, LAE, MSAE
# Contents

**Preface** vii

**Acknowledgements** viii

*Introduction: An overview of the automotive air-conditioning market, training and qualifications* ix

## 1 Air-conditioning fundamentals
1.1 History of automotive air-conditioning systems 1
1.2 Introduction to heating and ventilation 6
1.3 The basic theory of cooling 26
1.4 Vapour compression refrigeration 39
1.5 Alternatives cycles 42
1.6 The air-conditioning system 57
1.7 The expansion valve system 58
1.8 The fixed orifice valve system (cycling clutch orifice tube) 59
1.9 Dual air-conditioning 61

## 2 Air-conditioning components
2.1 The compressor 62
2.2 The condenser 77
2.3 The receiver-drier/accumulator 81
2.4 The expansion valve/fixed orifice valve 84
2.5 The evaporator 89
2.6 Anti-frosting devices 91
2.7 Basic control switches 93

## 3 Air-conditioning electrical and electronic control
3.1 Electrical principles 95
3.2 Sensors and actuators 113
3.3 Testing sensors and actuators 159
3.4 Oscilloscope waveform sampling 172
3.5 Multiplex wiring systems 183
3.6 OBD and EOBD 188
3.7 How to read wiring diagrams 194
3.8 Automotive A/C manual control system (case study 1) 205
3.9 Automotive A/C auto temp control system (case study 2) 221
3.10 Automotive climate control system (case study 3) 238
## 4 Diagnostics and troubleshooting

4.1 Initial vehicle inspection 264  
4.2 Temperature measurements 266  
4.3 Pressure gauge readings and cycle testing 267  
4.4 A/C system leak testing 277  
4.5 Sight glass 282

## 5 Service and repair

5.1 Servicing precautions 283  
5.2 Refrigerant recovery, recycle and charging 288  
5.3 System oil 310  
5.4 System flushing 312  
5.5 Odour removal 316  
5.6 Retrofitting 317  
5.7 Replacement and adjustment of compressor components 318  
5.8 Fixed orifice valve remove and replace 335

## 6 The environment

6.1 Global warming 337  
6.2 The ozone layer 338

## 7 Legislation

7.1 Historical perspective 341  
7.2 US perspective 344

Appendices 352

Index 359