Global market review of automotive engine-cooling systems – forecasts to 2016

2009 edition
Global market review of automotive engine-cooling systems – forecasts to 2016

2009 edition

February 2009

by Matthew Beecham

Published by

Aroq Limited
Seneca House
Buntsford Park Road
Bromsgrove
Worcestershire
B60 3DX
United Kingdom

Tel: +44 (0)1527 573 600
Fax: +44 (0)1527 577 423
Web: www.just-auto.com

Registered in England no: 4307068
Single-user licence edition

This report is provided for individual use only. If you would like to share this report with your colleagues, please order additional copies or sign up for a multi-user licence by contacting:

Kathryn Wedgbury  
Research manager, just-auto.com  
Tel: +44 (0)1527 573 604  
Email: kathryn.wedgbury@just-auto.com

Copyright statement  
© 2009 All content copyright Aroq Limited. All rights reserved.

This publication, or any part of it, may not be copied, reproduced, stored in a retrieval system, or be transmitted in any form by any means electronic, mechanical, photocopying, recording or otherwise without the prior written permission of Aroq Limited. This report is the product of extensive research work. It is protected by copyright under the Copyright, Designs and Patents Act 1988. The authors of Aroq Limited’s research reports are drawn from a wide range of professional and academic disciplines. The facts within this report are believed to be correct at the time of publication but cannot be guaranteed. All information within this study has been reasonably verified to the author’s and publisher’s ability, but neither accept responsibility for loss arising from decisions based on this report.

Incredible ROI for your budget – single and multi-user licences
We understand the pressure your research budget is under and price our reports realistically. You won’t find our reports with four, or even five-figure price tags, but you will find that they make some of the competition look expensive. Each title is available to you on a single-user basis, supplied on the strict understanding that each title is not to be copied or shared. Alternatively, titles can be shared within departments or entire corporations via a cost-effective multi-user licence. Multi-user licences can also save you money by avoiding unnecessary order duplication. To further add value, all multi-user
copies are hosted on a password protected extranet for your department or company – saving you time, resources and effort when sharing research with your colleagues. To find out more about multi-user pricing, please contact Kathryn Wedgbury.

just-auto.com membership
From just GBP99/US$149/EUR120* a year you will gain access to a growing portfolio of exclusive management briefing reports, and also receive all new briefings for each year you are a member. As well as this impressive list of members' only reports, you also gain one year’s access to a constantly-updated stream of news, feature articles and analysis. Established in 1999, just-auto has rapidly evolved into the premier source of global automotive news, analysis and data for busy senior executives. For details of the current special joining offer visit: www.just-auto.com/offer.aspx

* Prices correct at time of publication.
Contents

Single-user licence edition ........................................................................................................ ii
Copyright statement .................................................................................................................. ii
Incredible ROI for your budget – single and multi-user licences .............................................. ii
just-auto.com membership ...................................................................................................... iii

Contents ...................................................................................................................................... iv

List of figures ............................................................................................................................. vi

List of tables ............................................................................................................................... vii

Preface ........................................................................................................................................ viii
Research methodology ............................................................................................................. viii
Report coverage ......................................................................................................................... ix
The author ................................................................................................................................... ix

Chapter 1 Introduction .............................................................................................................. 1

Chapter 2 The market ............................................................................................................... 2
Market trends ............................................................................................................................... 2
Market players ............................................................................................................................. 3
Behr ............................................................................................................................................ 3
Q&A with Behr-Hella Thermocontrol GmbH ........................................................................ 4
Calsonic Kansei ........................................................................................................................ 8
Delphi ......................................................................................................................................... 8
Denso ......................................................................................................................................... 8
Modine ........................................................................................................................................ 8
Valeo .......................................................................................................................................... 9
Visteon ....................................................................................................................................... 9
Others ......................................................................................................................................... 9
Q&A with Dytech ENSA .......................................................................................................... 10

Emerging markets ....................................................................................................................... 13
Market shares ............................................................................................................................. 14
OE radiator market ..................................................................................................................... 14
Global engine-cooling system market ....................................................................................... 14
North American engine-cooling system market ..................................................................... 15
European engine-cooling system market ................................................................................ 16
Market forecasts ......................................................................................................................... 17

Chapter 3 Technical review .................................................................................................... 26
Defining the elements ............................................................................................................... 26
Recent innovations .................................................................................................................... 30
Thermal management systems for hybrid vehicles ............................................................... 32

© 2009 All content copyright Aroq Ltd. All rights reserved.
<table>
<thead>
<tr>
<th>Chapter 4 Manufacturers</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behr</td>
<td>34</td>
</tr>
<tr>
<td>Calsonic Kansel</td>
<td>36</td>
</tr>
<tr>
<td>Delphi</td>
<td>37</td>
</tr>
<tr>
<td>Denso</td>
<td>37</td>
</tr>
<tr>
<td>Modine Manufacturing Co Ltd</td>
<td>41</td>
</tr>
<tr>
<td>Valeo</td>
<td>43</td>
</tr>
<tr>
<td>Visteon</td>
<td>46</td>
</tr>
</tbody>
</table>
List of figures

Figure 1: Worldwide manufacturer shares of the radiator market, 2008 (% of volume) .................. 14

Figure 2: Worldwide manufacturer shares of the engine-cooling system market, 2008 (% of volume) ................................................................. 15

Figure 3: North American manufacturer shares of the engine-cooling system market, 2008 (% of volume) ........................................................................... 16

Figure 4: European manufacturer shares of the engine-cooling system market, 2008 (% of volume) ........................................................................... 17

Figure 5: An oil cooler designed and produced by Behr ................................................................. 29

Figure 6: All-aluminium radiator of the BMW 7 Series ................................................................... 29
List of tables

Table 1: Engine-cooling system manufacturers and products supplied, 2009............................ 13

Table 2: OE radiator market volumes for passenger car applications, North America, Western
Europe, Japan, China, Argentina, Brazil, Korea, India, Australia, expected-, best-
and worst-case scenarios, 2005-2016 (units '000s)......................................................... 19

Table 3: OE radiator market values for passenger car applications, North America, Western
Europe and Japan, China, Argentina, Brazil, Korea, India, Australia, expected-, best-
and worst-case scenarios, 2005-2016 (EUR '000s)............................................................ 21

Table 4: OE engine-cooling system market values for passenger car applications, North America,
Western Europe, Japan, China, Argentina, Brazil, Korea, India, Australia, expected-
and worst-case scenarios, 2005-2016 (EUR '000s)............................................................ 24

Table 5: Behr’s Engine Cooling System division’s production, 2000-2007, (000’s of units)......... 34

Table 6: Denso’s engine-cooling systems operations in Japan, 2009.......................................... 39

Table 7: Denso’s engine-cooling systems production operations worldwide, 2009 .................... 39

Table 8: Modine Manufacturing sales by product line, fiscal years 2005-2008 (% of net sales) .... 42

Table 9: Valeo Engine Cooling facilities worldwide, 2009....................................................... 45
Preface

Research methodology

This report is intended to provide an overview of vehicle engine-cooling systems, providing top level market fitment, volume and value forecasts through 2016. Our forecasts are not extrapolative but dependent on the underlying drivers of supply and demand. Our forecasts are largely based on interviews with the author's extensive international network of industry contacts. This allows us to consider and explain the meaning and implications of industry events, rather than offer simple description based on incomplete data.

Our approach is divided into two distinct methodologies:

- qualitative interviews – these are generally opinion-based, which aim to build knowledge about future vehicle engine-cooling system market trends and company strategies; and
- quantitative interviews – typically fact-based, focused on establishing market values, shares, and volumes.

Our research typically concentrates on applications for light vehicles which include all cars, light trucks and the various cross-over vehicle styles such as sports utility vehicles and people carriers. These vehicles collectively account for about xx% of the global vehicle build.

Since our last review of engine cooling was published in June 2007, the outlook for the automotive industry has significantly changed. In late 2007, we were looking at a ‘managed slowdown’ for the global economy and the automotive industry was very much part of that. By the end of 2008, however, major companies were struggling to keep their heads above water in the face of collapsed automotive markets.

On 19 December 2008, President Bush said that his administration will provide US$xxxxbn in short-term loans to GM and Chrysler. The money will come from the $xxxbn Troubled Asset Relief Programme (TARP), originally intended to provide financial institutions with emergency liquidity. While component suppliers to GM and Chrysler welcomed the news, the direct impact of vehicle production cutbacks will be felt the component industry well into 2009.
Given the current state of the industry, just-auto has completely revised its estimates and forecasts of the OE engine-cooling market volumes and values. This report therefore sets out our revised forecasts for engine cooling based on JD Powers & Associates’ forecasts for passenger car vehicle assembly in North America, Western Europe and Japan from 2005 through to 2013. Given that our in-house component forecasts set out the next seven years, we have extended JD Powers predictions by a further three years to 2016. In addition, and given the sheer volatility of the global economy at present, we have set out an ‘expected’, ‘best case’ and ‘worst case’ scenario applied to OE passenger car radiators and engine-cooling modules. On balance, we believe this will provide a more realistic framework for our component forecasts.

Report coverage

In this, the fifth edition of this report, just-auto reviews the key market drivers for vehicle engine-cooling systems, and updates the market analysis. Following our market overview in Chapter 1, just-auto’s product fitment forecasts in Chapter 2 predict the market (by volume and value) worldwide (and by major car-producing region) for OE radiator and engine-cooling systems. Chapter 3 reviews the technical advances in engine-cooling systems, defining the parts that make up the system as well as what we can expect to see in tomorrow’s cars. Chapter 4 sets out brief profiles of the major manufacturers, namely Behr, Calsonic Kansei, Delphi, Denso, Modine Manufacturing, Valeo and Visteon.

The author

Matthew Beecham has more than 15 years’ experience of researching, writing and analysing market and technical trends in the global automotive components industry. Since 2000, he has served as an associate editor for just-auto. In addition to engine-cooling systems, he authors a range of global auto components’ market research reviews, including batteries, braking systems, clutches, coatings, cockpits, driver assistance systems, door modules, electric motors, exhaust systems, front-end modules, fuel injection, fuel tanks, glazing systems, ignitions, interiors, lighting, mirrors, roof systems, shock absorbers, spark plugs, rotating electrics, tyre pressure monitoring systems, tyres, wheels and wipers. Matthew’s freelance assignments have included working for AT Kearney, McKinsey, Kuwait Institute for Scientific Research, Motorsport Industry Association, Motor Industry Research
Association and the Economist Intelligence Unit. He has also written for magazines including *Car Graphic* (Japan), *JAMA* (Japan) and *Automotive Engineer* (UK). He was awarded a PhD in automotive technology transfer from Cranfield University.
Chapter 1 Introduction

Thermal energy flows are an important part of a vehicle’s energy balance. Even in the most advanced diesel engines, the vehicle drive uses barely one-third of the fuel energy. The task of engine cooling is to draw waste heat out of the engine in order to allow the engine to operate efficiently. Behr states that the key trends its engine-cooling business faces are turbocharging and exhaust gas recirculation. The combination of the two will enable compliance with stricter emissions standards while offering minimum fuel consumption. The company says it is accelerating the development of these systems with new components.

Although hybrids have not really created a substantial change in the heat transfer philosophy of the engine, we asked manufacturers if this technology has created the need for additional product on the electronic side of the system. In an exclusive interview with just-auto, Dr Simon Edwards, director of advanced engineering, Engine Cooling, Behr Group, told us: “Yes, there are additional cooling requirements for battery cooling and power electronics/converter cooling. Li-Ion batteries have an upper temperature limit of around xx° C. High temperatures reduce the lifetime of the battery. Under warm climate conditions the Li-Ion battery therefore has to be cooled with the aid of the air conditioning system. Converter cooling requires a coolant temperature of around xx° C. Therefore so called low-temperature radiators are required in addition to the normal power train radiator.”
Chapter 2 The market

Market trends

“Further innovation in cooling systems and components is required in the industry due to a range of trends,” stated Denso in its 2008 annual report. “The challenge will be to meet demands from automakers for improved engine efficiency and output, as well as respond to rising production of diesel vehicles and direct-injection and turbocharged gasoline vehicles. In terms of social trends and legal regulations, demands for improved fuel efficiency due to surging gasoline prices and stricter fuel consumption regulations, as well as for more compact and thinner radiators and other parts in response to the more stringent legislation designed to protect pedestrians are also having an impact.” In response to these trends, Denso says that in the case of diesel vehicles and direct-injection and turbocharged gasoline vehicles, the company is developing optimised cooling systems by linking them with ECMs, intercoolers and exhaust gas recirculation coolers. The company’s engineers are developing thermal management system products based on applied waste heat recovery, heat exchange and other technologies.

Packaging the engine-cooling system is another major driver of innovation. Engine-cooling systems must fit into ever-smaller spaces under the bonnet. Given the pressure on supplier to squeeze higher performing products and systems into a smaller space under the bonnet, radiators have gradually become smaller in size. For example, a modern aluminium radiator is about two-thirds the size of a unit produced in the late 1970s. The high cost of fuel, particularly in Europe, means that designers are seeking ways of reducing the airflow in the car, which is leading towards the use of smaller heat exchangers.

Not only are auto engine-cooling parts becoming smaller but there is a clear trend toward more component integration. For example, combining the condenser and radiator can save space and help cut costs. Modularity plays an important role in packaging engine-cooling systems. This approach can, of course, help cut costs and simplify the entire installation on the assembly line.

As the pressure on suppliers to make engine-cooling parts thinner and lighter without any loss of strength continues, OEMs must consider the need to recycle parts at the end of their useful life, too. Although North American
Chapter 3 Technical review

Defining the elements

A typical cooling system consists of an engine water jacket, thermostat, water pump, radiator, cooling fan, hoses, heater core, oil cooler and overflow, or expansion tank. There are two types of cooling systems: air and water cooling.

As the name suggests, air cooling systems involve fans which blow air over the engine block. According to Bosch, heat absorbed by the engine oil is dispersed by an air-cooled oil cooler mounted at a suitable position in the air stream. The noise emission level and the inefficiency in maintaining consistent engine temperatures are considered to be disadvantages compared to liquid-cooled engines. Today, air cooling is mainly used for motorcycle engines and in special applications. The oil cooler is a heat exchanger that uses an air-cooling system to maintain the optimised oil temperature of vehicle oils, including engine oil and automatic transmission oil.

Water-cooled engines, on the other hand, have passages for the coolant to pass through the engine, absorbing the heat generated so it can be released through the radiator. The cooled fluid is recirculated around the engine while running. Water cooling has become the standard in both passenger cars and heavy-duty vehicles. Instead of pure water, coolants are now a mixture of water (drinking quality), anti-freeze and various corrosion inhibitors, says Bosch. An antifreeze concentration of xx-xx% raises the coolant mixture boiling point to allow operating temperatures of up to xxx° C at a pressure of xxx bar in passenger cars.

‘Thermal management’ means products such as radiators, charge-air coolers and oil coolers that use a medium (air or liquid) to cool the heat that is produced by a vehicle engine.

As the primary component of the cooling module, the radiator includes the radiator core, the coolant tank and all the connections. The radiator core itself consists of a finned tube system with tube headers and side supports. The cores of the coolant radiators in passenger cars are almost exclusively made of aluminium. Aluminium radiators are also being used to an increasing extent in a range of commercial vehicles worldwide.
Chapter 4 Manufacturers

Behr

Germany’s Behr specialises in automotive air conditioning and engine-cooling systems. The company is a major producer of engine-cooling products, including radiators, charge-air coolers, engine-cooling modules, Visco fans and fan drives, oil coolers, condensers and exhaust gas heat exchangers.

Behr’s Engine Cooling Systems business accounted for xxxx% of Behr’s turnover in 2007. The following table indicates the group’s engine-cooling divisional production output between 2000 and 2007.

Table 5: Behr’s Engine Cooling System division’s production, 2000-2007, (000’s of units)

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiators and charge-air coolers</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
</tr>
<tr>
<td>Engine-cooling modules</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
</tr>
<tr>
<td>Oil coolers</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
</tr>
<tr>
<td>Condensers</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
</tr>
<tr>
<td>Visco fan clutches</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
<td>xxxx</td>
</tr>
</tbody>
</table>

Source: Behr

During 2007, Behr began producing a number of engine-cooling innovations, including a corrosion-resistant charge-air cooler for low pressure exhaust gas recirculation and the world’s first air-cooled exhaust gas heat exchanger.

Over the past few years, Behr has strengthened its presence in North America, acquiring DaimlerChrysler’s thermal systems business, opening a factory in Webberville, Michigan and a new headquarters and technical centre in Troy, Michigan. In 2006, Behr America doubled the size of its North American headquarters in Troy. The company added a US$xxxx, xxxxx-ft² office building, increasing the overall size of its four-year-old North American headquarters and technical centre by more than xx%. The new building has capacity for some xxx workers.
### Fax order form

<table>
<thead>
<tr>
<th>Product Ref</th>
<th>Report Title</th>
<th>Price (£ / $ / €)</th>
</tr>
</thead>
<tbody>
<tr>
<td>72808</td>
<td>Global market review of automotive engine-cooling systems – forecasts to 2016</td>
<td>£415</td>
</tr>
</tbody>
</table>

Name:  
Company Name:  
Address:  
Post / Zip code:  
Telephone no:  
Fax no:  
Email address:  
VAT number: (If applicable)  
Purchase order number: (your ref)

How would you like to pay for your order? Please complete the details below

Payment method: (please circle)  
- Visa  
- Mastercard  
- AMEX  
- Proforma invoice

Which currency would you like to use? (please circle)  
- £ - GBP  
- $ - US dollars  
- € - EUR

Credit card number:  
Credit card expiry date:  
Name on credit card:  
Security code on credit card:  

Please fax this form to: +44 (0)1527 577 423