### CONTENTS

**Diary of Events**

- November 2000: Page 4
- December 2000: Page 5
- January 2001: Page 6

**Book Review**: Page 7

**PRESS RELEASE**: Page 8

**Abstracts from the Literature**: Page 12

**MOTOR INDUSTRY**

- COMPANY REVIEWS: Page 13
- TRAFFIC AND TRAFFIC CONTROL: Page 14
- ACCIDENTS: Page 15
- ACCIDENT SIMULATION/CASHER TESTS: Page 19
- ENVIRONMENTAL CONCERNS: Page 21

**VEHICLES - DESIGN AND PERFORMANCE**

- General: Page 23
- VEHICLE DESIGN AND PERFORMANCE - SPECIFIC MODELS: Page 26
- ELECTRIC VEHICLES: Page 43
- ALTERNATIVELY POWERED VEHICLES: Page 43
- NOISE AND VIBRATION HARMONY (NVH): Page 45
- AERODYNAMICS: Page 45
- BRAKING PERFORMANCE: Page 46
- ERGONOMICS: Page 46
- SAFETY - GENERAL VEHICLE SAFETY: Page 47

**Components**

- BODY DESIGN: Page 49
- SAFETY COMPONENTS - AIRBAGS, RESTRAINTS, ETC: Page 49
- HEATING, VENTILATING AND COOLING (HVAC): Page 51
- INTERIOR FITTINGS: Page 51
- STRUCTURAL MECHANICS: Page 53
- SUSPENSION SYSTEMS: Page 53
- STEERING SYSTEMS: Page 54
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRAKING EQUIPMENT</td>
<td>55</td>
</tr>
<tr>
<td>ANTI-LOCK SYSTEMS</td>
<td>55</td>
</tr>
<tr>
<td>TYRES</td>
<td>56</td>
</tr>
<tr>
<td>COMBUSTION</td>
<td>63</td>
</tr>
<tr>
<td>EMISSIONS</td>
<td>64</td>
</tr>
<tr>
<td>ENGINE COMPONENTS</td>
<td>66</td>
</tr>
<tr>
<td>ENGINE COMPONENTS - FILTERS</td>
<td>66</td>
</tr>
<tr>
<td>ENGINE COMPONENTS - FUEL SYSTEMS</td>
<td>66</td>
</tr>
<tr>
<td>ENGINE COMPONENTS - IGNITION SYSTEMS</td>
<td>67</td>
</tr>
<tr>
<td>ENGINE COMPONENTS - CYLINDER HEADS AND BLOCKS</td>
<td>68</td>
</tr>
<tr>
<td>ENGINE COMPONENTS - VALVES AND VALVE GEAR, CAMS AND TAPPETS</td>
<td>68</td>
</tr>
<tr>
<td>ENGINE COMPONENTS - LUBRICATION SYSTEMS</td>
<td>69</td>
</tr>
<tr>
<td>ENGINE COMPONENTS - EXHAUST SYSTEMS</td>
<td>69</td>
</tr>
<tr>
<td>Batteries, Fuel Cells and Flywheel Technology</td>
<td>70</td>
</tr>
<tr>
<td>AXLES, TRACTION CONTROL AND POWER TRAINS</td>
<td>73</td>
</tr>
<tr>
<td>ELECTRICAL SYSTEMS</td>
<td>74</td>
</tr>
<tr>
<td>LIGHTING, SIGNALLING AND DRIVER INFORMATION SYSTEMS</td>
<td>75</td>
</tr>
<tr>
<td>ELECTRONICS, EMC, FIBRE OPTICS</td>
<td>75</td>
</tr>
<tr>
<td>Fluids</td>
<td>77</td>
</tr>
<tr>
<td>Hydraulic fluids</td>
<td>77</td>
</tr>
<tr>
<td>COOLANTS</td>
<td>77</td>
</tr>
<tr>
<td>Materials</td>
<td>78</td>
</tr>
<tr>
<td>MATERIALS</td>
<td>78</td>
</tr>
<tr>
<td>FERROUS METALS</td>
<td>82</td>
</tr>
<tr>
<td>NON-FERROUS METALS</td>
<td>83</td>
</tr>
<tr>
<td>Plastics and Rubber</td>
<td>84</td>
</tr>
<tr>
<td>COATINGS</td>
<td>84</td>
</tr>
<tr>
<td>Other Materials</td>
<td>85</td>
</tr>
<tr>
<td>Recycling/End-of-Life Vehicles</td>
<td>88</td>
</tr>
<tr>
<td>Production</td>
<td>89</td>
</tr>
<tr>
<td>Research</td>
<td>91</td>
</tr>
<tr>
<td>Testing</td>
<td>93</td>
</tr>
<tr>
<td>Road Tests</td>
<td>96</td>
</tr>
<tr>
<td>Index</td>
<td>98</td>
</tr>
<tr>
<td>AUTOMOBILE ABSTRACTS ORDER FORM</td>
<td>103</td>
</tr>
</tbody>
</table>
MIRA is the leading independent automotive research, development and technology centre. MIRA is renowned for specialising in advanced engineering, technology co-ordination, information services, body and safety engineering, materials technology, powertrain and emissions, electrical and electronic systems, climatic technology, thermo-fluid technologies, ergonomics and analysis, vehicle dynamics, refinement, component engineering, vehicle development and vehicle proving.

For more information call:+44 (0)24 7635 5275 or fax +44 (0)24 7635 5069
## NOVEMBER 2000

<table>
<thead>
<tr>
<th>WHEN</th>
<th>WHAT</th>
<th>WHERE</th>
<th>CONTACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>09 Oct 2000 - 10 Nov 2000</td>
<td>BSSA Millenium</td>
<td>Midlands, UK</td>
<td>Mr D B Corns, Secretary, BSSA, 6th Floor, The McLaren Building, 35 Dale End, Birmingham B4 7LN, UK.</td>
</tr>
<tr>
<td>30 Oct 2000 - 02 Nov 2000</td>
<td>SAE International Truck and Bus Meeting</td>
<td>Oregon Convention Centre, Portland, USA</td>
<td>Tel: +1 724 772 8516</td>
</tr>
<tr>
<td>31 Oct 2000 - 03 Nov 2000</td>
<td>Specialty Equipment Market Association/ Auto International</td>
<td>Las Vegas, NV, USA</td>
<td>Epic Enterprises Inc, Tel: +1 619 294 2999, Fax: +1 619 294 6699</td>
</tr>
<tr>
<td>01 Nov 2000 - 01 Nov 2000</td>
<td>SAE Materials in the Auto Industry</td>
<td>Melbourne, Australia</td>
<td>Tel: +61 3 9326 7166</td>
</tr>
<tr>
<td>01 Nov 2000 - 02 Nov 2000</td>
<td>Computational and Experimental Methods in Reciprocating Engines</td>
<td>1 Birdcage Walk, London, UK</td>
<td>Tel: +44 0297304 6864</td>
</tr>
<tr>
<td>02 Nov 2000 - 05 Nov 2000</td>
<td>International Auto and Truck Show</td>
<td>Henry B Gonzalez Convention Center, San Antonio, USA</td>
<td>Tel: +210 732 9647</td>
</tr>
<tr>
<td>02 Nov 2000 - 12 Nov 2000</td>
<td>Autoshow</td>
<td>Istanbul, Turkey</td>
<td>ITE +44 (0) 20 7596 5000; Fax +44 (0) 20 7596 5111; E-mail <a href="mailto:press@ite-exhibitions.com">press@ite-exhibitions.com</a></td>
</tr>
<tr>
<td>06 Nov 2000 - 09 Nov 2000</td>
<td>7th World Road Congress on ITS - Vision to Reality</td>
<td>Turin, Italy</td>
<td>Tel: +32 2 400 07 07</td>
</tr>
<tr>
<td>06 Nov 2000 - 09 Nov 2000</td>
<td>Euromat 2000 - Topical European Conference on New Approach of Mechanical Behaviour</td>
<td>Loire Region, France</td>
<td>Tel: +33 (1) 46 54 76 41</td>
</tr>
<tr>
<td>06 Nov 2000 - 09 Nov 2000</td>
<td>ITS World Congress</td>
<td>Turin, Italy</td>
<td>Tel: +32 2 400 07 07</td>
</tr>
<tr>
<td>07 Nov 2000 - 07 Nov 2000</td>
<td>Fuel Economy Roadshow</td>
<td>IMechE Headquarters</td>
<td>Kate Lewis: +44 (0) 20 7973 1245</td>
</tr>
<tr>
<td>07 Nov 2000 - 08 Nov 2000</td>
<td>7th Annual Congress of Auto 2000</td>
<td>Automobile Club de France - Paris</td>
<td>Fax 01 43 12 43 93</td>
</tr>
<tr>
<td>07 Nov 2000 - 09 Nov 2000</td>
<td>Euromat 2000</td>
<td>Tours, France</td>
<td>Societe Francaise de Metallurgie et de Materiaux, Les Fontenelles, 1 rue de Craiova, F-92024 Nanterre Cedex, France</td>
</tr>
<tr>
<td>07 Nov 2000 - 09 Nov 2000</td>
<td>InterAuto 2000</td>
<td>Kolin Messe, Kolin, Germany</td>
<td>Anna crisp(Tel: +44 01895 454533)</td>
</tr>
<tr>
<td>07 Nov 2000 - 09 Nov 2000</td>
<td>Manufacturing Week 2000</td>
<td>Hall 1, NEC, Birmingham</td>
<td><a href="http://www.manweek.co.uk">www.manweek.co.uk</a></td>
</tr>
<tr>
<td>07 Nov 2000 - 10 Nov 2000</td>
<td>2nd International Conference on Whole-Body Vibration Injuries</td>
<td>Siena, Italy</td>
<td><a href="mailto:socrate@sisted.it">socrate@sisted.it</a></td>
</tr>
<tr>
<td>08 Nov 2000 - 10 Nov 2000</td>
<td>50th Anniversary Conference of the South African Road Federation - Roads for South Africa- The Essential Infrastructure</td>
<td>Cape town, South Africa</td>
<td>Fax: +27 11 403 7736</td>
</tr>
<tr>
<td>13 Nov 2000 - 16 Nov 2000</td>
<td>Motorsports Engineering Conference &amp; Exposition</td>
<td>Hyatt Regency, Dearborn, USA</td>
<td>Tel: +1 724 772 7131</td>
</tr>
<tr>
<td>14 Nov 2000 - 14 Nov 2000</td>
<td>Systems and Service</td>
<td>The Lucas Centre, National Exhibition Centre, Birmingham</td>
<td>Email: <a href="mailto:susan.knight@bl.uk">susan.knight@bl.uk</a></td>
</tr>
<tr>
<td>15 Nov 2000 - 16 Nov 2000</td>
<td>Global Automotive Logistics</td>
<td>Princesa Sofia, Inter Continental, Barcelona, Spain</td>
<td>Email: <a href="mailto:michelle.fisk@iirx.co.uk">michelle.fisk@iirx.co.uk</a></td>
</tr>
<tr>
<td>15 Nov 2000 - 17 Nov 2000</td>
<td>The 8th Annual United States Hot Mix Asphalt Conference</td>
<td>Cincinnati, USA</td>
<td>Fax +1 301 731 4621</td>
</tr>
<tr>
<td>15 Nov 2000 - 18 Nov 2000</td>
<td>5th International Exhibition on Road and Water Transport Technology and Equipment</td>
<td>Beijing, China</td>
<td>Fax: +86 10 6491 4814</td>
</tr>
</tbody>
</table>
### WHEN | WHAT | WHERE | CONTACT
--- | --- | --- | ---
15 Nov 2000 - 18 Nov 2000 | China Transpo 2000 (5th International Exhibition on Road and Water Transport Technology and Equipment) | Beijing, China | Fax +86 10 6425 1287
16 Nov 2000 - 16 Nov 2000 | TWI - Best practice inspection - the key to structural integrity assurance | Aberdeen, Scotland | Email - pse@twi.co.uk
20 Nov 2000 - 21 Nov 2000 | Automotex | London International Exhibition Centre (ExCeL) London | Tel: +44 020 7886 3117 - (ImechE)
20 Nov 2000 - 21 Nov 2000 | LED - Technology in Auto - Innovation for Comfort and Security | Augsburg, Germany | Email: hdt@hdt-essen.de
21 Nov 2000 - 23 Nov 2000 | Autotech International | NEC Birmingham | Email: enquiries@autotech.org
22 Nov 2000 - 23 Nov 2000 | Automotive Technology Conference | The Savoy Hotel, London | Fax: +44 (0) 20 7453 2739
27 Nov 2000 - 28 Nov 2000 | Tyre Tech 2000 | Warsaw Marriott Hotel, Warsaw, Poland | Tel: +44 1939 250383 | Fax: +44 1939 251118 | E-mail: conferences@rapra.net
29 Nov 2000 - 01 Dec 2000 | EyeForAuto USA 2000 | The Fairmont Hotel, San Jose, California | Email: register@eyeforauto.com
29 Nov 2000 - 01 Dec 2000 | The Need for Speed in Today's global Supply Chain | Hilton Hotel, Strasbourg, France | Email: aene@networkevents.co.uk
30 Nov 2000 - 01 Dec 2000 | 15th Annual POLIS Conference: Translating the Kyoto Targets into Local Transport Actions across Europe | City Hall, Prague | Javier Fernandez Lopez - Email: polis@polis-online.org
30 Nov 2000 - 01 Dec 2000 | Alternative Automotive Propulsion Systems | Haus der Technik, Hollestrabe, Essen | Fax: +49 201 18 03-280
04 Dec 2000 - 06 Dec 2000 | International Truck & Bus Meeting & Exposition | Portland, USA | Tel: +1 724 772 7131 | Fax: +1 724 776 0002
05 Dec 2000 - 06 Dec 2000 | Incar Tech | Cnit - Paris | www.incar-tech.com
05 Dec 2000 - 06 Dec 2000 | International Emissions | One Birdcage Walk, London | Tel: +020 7973 1312
06 Dec 2000 - 07 Dec 2000 | Diesel an Petrol Direct Injection | Hotel Berlin, Lutzwoplatz, Berlin | Email: hdt@hdt-essen.de
07 Dec 2000 - 07 Dec 2000 | TWI - Achieving best practice in welding production - a guide to the use (and abuse) of EN 729 | Institute of Physics in London | Email: pse@twi.co.uk
07 Dec 2000 - 09 Dec 2000 | The Americas Exchange and IRF/CIMA Conference on Road and Construction Technologies | Miami Beach, USA | Fax: +1 414 272 2672
11 Dec 2000 - 12 Dec 2000 | In-Vehicle Telematics | Simpsons-in-the-Strand, London | EuroForum, 45 Beech Street, London EC2Y 8AD, UK | Tel: +44 (0)20 7878 6888 | Fax: +44 (0)20 7878 6885
12 Dec 2000 - 16 Dec 2000 | Auto South China | Guangzhou, China | Tel: +86 020 7344 9230 | Email: mnorcliffe@smmt.co.uk
29 Dec 2000 - 04 Jan 2000 | 4th Austroads Bridge Engineering Conference | Adelaide Hilton, Australia | Dean Whiltford | Fax: +61 8 8343 2119

### DECEMBER 2000

WHEN | WHAT | WHERE | CONTACT
--- | --- | --- | ---
04 Dec 2000 - 05 Dec 2000 | 21st Century Emission Technology | 1 Birdcage Walk, London | Stephanie Love, +44 (0)20 7973 1312
04 Dec 2000 - 06 Dec 2000 | International Truck & Bus Meeting & Exposition | Portland, USA | Tel: +1 724 772 7131 | Fax: +1 724 776 0002
05 Dec 2000 - 06 Dec 2000 | Incar Tech | Cnit - Paris | www.incar-tech.com
05 Dec 2000 - 06 Dec 2000 | International Emissions | One Birdcage Walk, London | Tel: +020 7973 1312
06 Dec 2000 - 07 Dec 2000 | Diesel an Petrol Direct Injection | Hotel Berlin, Lutzoplatz, Berlin | Email: hdt@hdt-essen.de
07 Dec 2000 - 07 Dec 2000 | TWI - Achieving best practice in welding production - a guide to the use (and abuse) of EN 729 | Institute of Physics in London | Email: pse@twi.co.uk
07 Dec 2000 - 09 Dec 2000 | The Americas Exchange and IRF/CIMA Conference on Road and Construction Technologies | Miami Beach, USA | Fax: +1 414 272 2672
11 Dec 2000 - 12 Dec 2000 | In-Vehicle Telematics | Simpsons-in-the-Strand, London | EuroForum, 45 Beech Street, London EC2Y 8AD, UK | Tel: +44 (0)20 7878 6888 | Fax: +44 (0)20 7878 6885
12 Dec 2000 - 16 Dec 2000 | Auto South China | Guangzhou, China | Tel: +86 020 7344 9230 | Email: mnorcliffe@smmt.co.uk
29 Dec 2000 - 04 Jan 2000 | 4th Austroads Bridge Engineering Conference | Adelaide Hilton, Australia | Dean Whiltford | Fax: +61 8 8343 2119
### JANUARY 2001

<table>
<thead>
<tr>
<th>WHEN</th>
<th>WHAT</th>
<th>WHERE</th>
<th>CONTACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Jan 2001 - 12 Jan 2001</td>
<td>SAFE Highways of the Future 2001</td>
<td>Cannes, France</td>
<td>Email: <a href="mailto:safehighways@ukintpress.com">safehighways@ukintpress.com</a></td>
</tr>
<tr>
<td>10 Jan 2001 - 12 Jan 2001</td>
<td>Tire Technology Expo 2001</td>
<td>Cannes, France</td>
<td>Tel: +44 01306 743744/Fax: +44 01306 742525/E-mail: <a href="mailto:tire@ukintpress.com">tire@ukintpress.com</a>/www.ukintpress.com/tire/expo</td>
</tr>
<tr>
<td>10 Jan 2001 - 13 Jan 2001</td>
<td>SIAT 2001 - Technology Challenges for Euro 11 &amp; Beyond</td>
<td>Pune, India</td>
<td>Tel: +91 20 5437180/82/85 ext-320/Fax: +91 20 5434190/E-mail: <a href="mailto:ogale.shl@araiindia.com">ogale.shl@araiindia.com</a>/siat2001@araiindia.com</td>
</tr>
<tr>
<td>22 Jan 2001 - 25 Jan 2001</td>
<td>Worklife 2000</td>
<td>Solna, Sweden</td>
<td>Tel: +46 8 730 90 71/Fax: +46 8 27 01 48/E-mail: <a href="mailto:arne.wennerg@niwl.se">arne.wennerg@niwl.se</a></td>
</tr>
</tbody>
</table>

To view further forthcoming events, please visit the Diary of Events Database available at [http://www.mira.co.uk/aic](http://www.mira.co.uk/aic)
ISATA 2000 Conference Proceedings

ISATA
Price £100 (per volume)

The 33rd meeting of ISATA was held in Dublin, Ireland on the 25-27 September 2000. This annual event produces some of the most important technical/research papers in the Automotive Industry, with this year’s event being no exception. Recently published, the ISATA 2000 set of conference proceedings are now available at a provisional cost of £100 per volume (each volume represents a specific track/topic of the event).

Currently available for purchase are the following tracks:

- Safety - Crashworthiness, Mobility, Occupant Safety (ISBN 1-902856-10-4)
- Advanced Manufacturing - Modular Manufacturing, Supplier Integration, Production Planning (ISBN 1-902856-16-3)
- Lasers and Joining Applications (ISBN 1-902856-17-1)
- Simulation and Virtual Reality (ISBN 1-902856-14-7)
- Automotive Electronics (ISBN 1-902856-12-0)

For more information, contact:

ISATA Conferences UK,
Ground Floor,
Epsom House,
10c East Street,
Epsom,
Surrey,
KT17 1HH.
United Kingdom
Tel +44 (0) 1372 720620, Fax +44 (0) 1372 720101, Website http://www.isata.com
To order copies of ISATA papers online, please visit this website direct.
Are your vehicles maintained for the 21st century?

A range of expert speakers will tackle the problem of poor vehicle maintenance at a Brake and Automotive Distribution Federation conference. This one-day conference, Commercial Vehicle Maintenance in the 21st century, is being held on 15 February 2001 at Volvo Bus & Truck, Warwick.

There are more than three million commercial vehicles on UK roads. About 7% of fatal crashes involving these vehicles are caused by inadequate maintenance and poor vehicle and component specification.

This conference aims to highlight these problems and show ways of improving commercial vehicle maintenance.

The conference is aimed at road safety professionals including vehicle engineers, fleet and risk managers, component distributors and dealerships, component and vehicle manufacturers, public service vehicle operators, mechanic training providers and garage employees.

Delegates will hear a range of speakers covering topics such as:

- liabilities of the O licence holder;
- advancements in vehicle technology and what the future holds;
- issues to consider when choosing between maintaining vehicles in-house or contracting out;
- what makes a competent mechanic?;
- How to ensure the correct, quality components are used;
- Additional safety systems and when they should be fitted.

Speakers from road safety, fleet management, engineering and training backgrounds include:

- Mary Williams OBE, executive director, Brake;
- John Parry, director of engineering, Exel logistics;
- Steve Davis, national service manager, TNT;
- Roy Burden, deputy head engineer, Civil Aviation Authority;
- Sheila McGregor, chief executive, Motor Industry Training Council;
- David Oakeley, communications executive, Society of Operations Engineers;
- Louise Bedford, training operations manager, Volvo Truck and Bus;
- Brian Spratt, chief executive, ADF;
- David Smith, consultant engineer, TMD Friction;
- Andrew Preston, sales engineer, Voith Retarders.

For further details and to register your place, please contact Caroline Taylor at Brake on Tel: 01484 559909.
Costs: £195.00 + VAT (for non-members)
£120.00 + VAT (for members of Brake’s Fleet Safety Forum and members of the ADF)

Non-members can join **Brake’s Fleet Safety Forum for £75.00** and obtain the discounted member’s rate. Minutes of the conference are available for £10 to professionals who are unable to attend the event.

**Notes for editors:**

Brake is a national not-for-profit road safety organisation. Brake exists to stop the 3,400 deaths and 41,000 serious injuries that occur on Britain’s roads every year and to care for people traumatised by road crashes. Brake produces educational road safety literature and runs events including Road Safety Week. Brake’s Forum for road safety professionals, the Road Risk Forum, has been renamed the **Fleet Safety Forum** to represent the majority of its members – fleet managers and people with an interest in fleet safety. Brake is funded by corporate partners; Aon, Avis Rent A Car Ltd, BG Transco plc, Bibby Distribution Ltd, Boalloy Industries Ltd, Christian Salvesen Industrial Division, City Trucks Ltd, Continental Tyre Group Ltd, DON, Drive & Survive, DriveCare UK Ltd, Eddie Stobart Ltd, Exel Logistics – Europe, Federal-Mogul Aftermarket UK Ltd, Granada Motorway Services, Green Flag Motoring Assistance, Hays, Ideas in Action Ltd, The Instructor College Ltd, Iveco Ford Truck Ltd, Jaguar Cars Ltd, KeyMed Ltd, Leaseway, The Leasing Group, Lyons Davidson Solicitors, Mercedes-Benz, Meritor, P&O Trans European, Safeway, Sainsbury’s, TNT UK Ltd, Transport Development Group, Volvo Truck and Bus Ltd, Willis Corroon Ltd, Wincanton Logistics.
The comfort, reliability, efficiency, safety and costs associated with road transportation are profoundly influenced by the interaction between pneumatic tyres and pavement surfaces. While there have been enormous advances in the design and construction of these components in recent years, there is still much to investigate and analyse in both describing the dynamic performance of such complex reinforced structures and in elucidating some of the fundamental tribological mechanisms relevant to the contact between a highly visco-elastic material and a rigid counterface in both dry and wet conditions.

This one-day seminar, which will draw on speakers from both academia and industry, will both review the current state of knowledge and provide a forum for the presentation of results from recent experimental work.

**Venue**

Council Room  
Institute of Mechanical Engineers  
1 Birdcage Walk  
Westminster  
London SW1H 9JJ

Further Information

Further information and on-line registration available at http://www.iop.org/IOP/Confs/RUB/

**Conference Co-ordinator**  
Rebecca Chapple  
Conferences Department  
The Institute of Physics  
76 Portland Place  
London W1B 1NT  
Tel: 0044 (0)207 4704800  

Programme Organiser, Dr J A Williams  
Department of Chemical Engineering  
Cambridge University  
Cambridge CB2 1PZ  
Tel: 0044 (0)1223 332625  
Email: jaw@eng.cam.ac.uk
Conference Programme

1030 Registration and Coffee

1100 A Simplistic Overview of Tyre/Road Interaction
   D F Moore (University College, Dublin)

1130 Improvements in Quality Control and Performance Retreated Tyres
   A D Roberts (The Tun Abdul Razak Research Centre)

1200 Energy Loss in Truck Tyres
   A Popov (University of Nottingham)

1230 Towards Better Road Transport
   A R Williams (Consultant)

1400 Developments in Characterising Tyre/Road Noise
   S Phillips (Transport Research Laboratory)

1430 Tyre Performance Evaluation
   J Whitehead (Motor Industry Research Association)

1500 Influence of Material Properties on Tyre Traction
   P Roch (Goodyear)

1530 Tea and Close
Abstracts from the Literature

MOTOR INDUSTRY

Current status of large experimental facilities

The Japan Automobile Research Institute (JARI) was founded in 1969 as a non-profit organization for promoting the progress of motorization in society at large. JARI is devoted chiefly to the solution of various social issues related to automobiles. In recent years, greater emphasis has been placed not only on the safety, environmental protection and energy conservation, but also Intelligent Transport System, fuel cell and recycling capabilities of automobiles. In order to solve these social issues, JARI makes various studies by using many facilities. This paper presents large experimental facilities in JARI.

ERF works

This article reports an interview with John Bryant, managing director of ERF. The interview describes the sale of ERF to MAN after initial interest from Mercedes. The relationship with MAN is described as very good, based on mutual engineering respect. The article reports how ERF and MAN explored synergies, describing the race to get the ECS to market before the Euro 3 deadline in October. Other synergies include the cab and chassis. The article discusses ERF's engine and transmission strategy.

The article speculates on MAN's plans for ERF to enter the light middleweight market. The effect of MAN's ownership of ERF in the UK in terms of market share and coverage is discussed.

ERF's new factory at Middlewich is briefly described, which will give 10% increased productivity.

As an aside, the article reports on Bryant's career, describing the rise in his reputation both in the UK and the States.

New Mercs break cover

This article shows photographs of new Mercedes-Benz truck models under development. The first model described is the new high power Atego tractor. This is thought to be due for its European launch this winter following a debut in Brazil. The article reports that the truck will use a 12.8 litre in line six engine derived from the 12 litre OM457 engine, and is said to offer 460hp. The engine will be equipped with a nine speed transmission and a Mercedes single reduction rear axle.

The second model to be discussed is the restyled Actros, expected to be launched in about a year's time. The major change appears to be the new front underrun bumper ahead of the expected legislative change, although the headlamps have been repositioned, and cab access appears to have been improved.

Thirdly, the new Mercedes A class-based light van range known as Vaneo, is shown undergoing final road testing. Having a deep windscreen and side windows for excellent
visibility and sleek styling, this model will challenge Renault Kangoo, Peugeot Partner and Citroen Berlingo.

Finally, the article publishes what it believes to be the first pictures of the restyled Vito. The pictures indicate that it will be offered with a new, longer wheelbase to increase load volume, with forward visibility improved. The new Vito is unlikely to be launched for at least two years. (RS)

COMPANY REVIEWS

Class pays
This article focuses on Peterbilt Motors, its expansion into European markets through acquisitions - notably Daf and Foden. Peterbilt has achieved greater market penetration with its 379 than Kenworth, as the residual values are good and the Peterbilt is favoured by drivers. However, Peterbilt and Kenworth are working together to produce the Daf 55 under both badges.

The article incorporates an interview with Peterbilt's chief engineer Craig Brewster, who discusses some of the technical aspects of Peterbilt trucks, and some engineering consequences following the takeover of Daf. The article then moves on to a similar interview with marketing director Scott Pearson, who comments on an apparent downturn in the market. The article includes an inset piece on the history of Peterbilt following T.A. Peterman's purchase of the Fageol Motor Car Company in 1938. (RS)

No guts, no glory
This article gives a profile of Finnish truck maker Sisu, following the end of its state ownership and start of the joint venture with Renault VI in January 1997. Sisu has an enviable reputation in Finland for building tough trucks for logging and gravel haulage. Each one is pre-equipped ex-factory, and built to order.

The article describes the extra-heavy-duty chassis frame, and the features required to keep the trucks operational during Finnish winters. The modifications required to the Renault VI cab are discussed. Engine supply - including proprietary engines - is covered, including plans to comply with Euro 3. Two figures outline the company profile and the product line up. (RS)

Up, up and away
This is a detailed profile of the Tyneside-based truck operator Simpson Brothers. The family owned concern has recently celebrated 80 years in the business, having expanded from a five truck operation in 1976 to a line-up of over 74, with 160 trailers today. As a packaging transporter, load space rather than weight is the limiting factor, which Simpson Bros. have attempted to counter by increasing load height, sometimes with an extra load-carrying internal floor. This has required axle modifications to maintain stability. Fuel consumption is, however, penalised.

The trucks used by Simpson Bros. are discussed - particularly Volvo, Scania and Leyland Daf. The company's recent purchases have favoured Volvo.
Two inset articles describe Simpson's mega trailer, and trace the early history of the business. (RS)

TRAFFIC AND TRAFFIC CONTROL

Australia - reaping rewards
A review of three electronic tolling systems in Australia is presented. The Melbourne CityLink is the nearly completed automated, fully electronic toll road based on the European CEN system. A number of toll roads in Sydney are described as are systems in Brisbane. (HL)

Automatic for the people
Looks at the first electronic toll collection system in turkey that is in operation on three highway sections countrywide and two major bridges in Istanbul. The article describes the automatic passing system and its development. (HL)

The drive to 5.9
Looks at work in the USA to achieve interoperability for electronic toll collection systems. In particular at the work of the IBTTA Electronic Performance Specifications Task Force to create an international consensus on performance specifications for ETC systems at the 5.8-5.9GHz frequency. (HL)

ERP : does one size fit all
This article gives an overview of some representative global developments in electronic road pricing (ERP). Including schemes and projects in Singapore, Hong Kong, South Korea, United Kingdom, Denmark, Norway, USA and Canada. (HL)

Europe - EFC's melting pot
Reviews current European Union funded electronic fee collection (EFC) projects. Including the A1 project that aims to achieve interoperability of European EFC systems, the STAR project working on standardisation, the ADVICE project that has developed and tested automatic classification and video enforcement systems for EFC, the INITIATIVE project is an industry initiative to introduce automatic tolling in vehicles in Europe, the VERA project looking at video enforcement for road authorities, the CESARE project and the MANS project. New projects are also looked at. (HL)
Late Britain
Looks at road charging in Britain. Including the DIRECTS (Demonstration of Interoperable Road-user Electronic Charging and Telematics Systems) project that will involve trials of EFC (Electronic Fee Collection) in Leeds and Edinburgh, and the PRoGRESS (Pricing Road use for Greater Responsibility, Efficiency and Sustainability in cities) project backed by EU funding. PRoGRESS aims to demonstrate congestion charging concepts and technologies in eight European cities including Bristol and Edinburgh. (HL)

Living with a legacy
This article reviews the state of the transport infrastructure in South Africa and the governments plans for the future. The work of the newly created South African Society for ITS (SASITS) and its plans to introduce electronic toll collection with one means of payment being common to all toll facilities is looked at. (HL)

Pay per mile. Switzerland’s distance-related heavy vehicles fee
Heavy vehicles on any Swiss road will soon have to pay a distance-related fee, differentiated according to weight and emissions. To achieve this a sophisticated fee collection system has been developed, with the fee being calculated from three parameters, distance driven on Swiss roads, maximum laden weight and emission values of the vehicle. The system and its operation is described. (HL)

PRoGRESS road user charging project
Eight cities will take part in the PRoGRESS road user charging project funded by the European Commission. Bristol, Rome, Trondheim, Edinburgh, Copenhagen, Gothenburg and Helsinki will spend the next four years developing and implementing concepts and technologies. They will work with key transport authorities, public transport operators and research institutes and consultancies to develop and assess the political, economic, and social framework required for urban transport pricing. (HL)

Space saver
Reviews Switzerland’s upcoming national Heavy Vehicle Fee scheme. The aim has been to develop a reliable fraud-resistant service and a GPS-based ERP system was chosen to achieve this. The operation and development of the scheme is described. (HL)

ACCIDENTS
Civil liability, criminal law, and other policies and alcohol-related motor vehicle fatalities in the United States: 1984-1995
This study examines the associations between alcohol policies and motor vehicle fatality rates from 1984 to 1995 in the United States. State policies and state characteristics variables were merged with motor vehicle fatality rates over an 11 year period and analyzed
using minimum logit chi-square method and fixed effects to create a quasi time-series analysis. Laws allowing individuals to sue bars for the drunken behaviour of their patrons were the policies most strongly associated with lower minor and adult fatality rates. The mandatory first offence fine was associated with lower minor fatality rates but not adult fatality rates, while minor and adult rates fell after administrative per se license suspension and anti-consumption laws for vehicle occupants. Many other public policies evaluated were not associated with lower fatality rates. (Auth)

Cohort effects in older drivers’ accident type distribution: are older drivers as old as they used to be?

Accident type distributions were compared in successive cohorts of older drivers, with focus on intersection accidents. It was thought that if the increasing share of intersection accidents is a truly age-related phenomenon, as opposed to cohort-related or time-related, it would remain fairly constant over time in different cohorts. The data consisted of Finnish traffic insurance data on private car accidents of drivers aged 60 yr or more who were legally responsible for causing the accident, and covered the years 1987-1995 (N = 56,481). Some changes in accident type distributions were found across cohorts. Among male drivers aged 60-79 yr, the portion of intersection accidents decreased in successive cohorts, so that the younger cohorts showed the age-typical accident picture at a somewhat later age than the older cohorts. In contrast, for male drivers aged 80 yr or more, there was an increase in the share of intersection accidents in more recent cohorts. Among female drivers, a decrease in intersection accidents only reached statistical significance for drivers aged 60-69 yr, and for the oldest age group (75+ yr) no change was observed. For both male and female drivers, the tendency to incur accidents at intersections increased with age in all cohorts. The occurrence of intersection accidents thus is both an age-related and a cohort-related phenomenon: age-related in the sense that it will emerge eventually, but with cohort-related variance in timing. (Auth)

Complementing police road-crash records with trauma registry data - an initial evaluation

This paper examines the consistency of hospital and police reporting of outcomes of road traffic crashes using a database of linked police crash reports and trauma registry records. Criteria for inclusion into the trauma registry include trauma-related causes with subsequent stay of more than 24 h or death due to injuries. During the 1997 calendar year there were 497 cases of road-related injuries within the combined trauma registry of Sir Charles Gairdner and Fremantle Hospitals, of which only 82% had matching police records. Linkage rates were associated with gender, injury severity and the number of vehicles involved. Within the road user category, pedestrians were least likely to link. Of the linked records, police classification of injury severity was correct in 78% of cases. Male casualties were more likely to be correctly classified than females, after adjustment for related variables including injury severity. Correct classification of injury by police was also closely related to severity of injury. Identification and targeting of these groups of casualties is vital in refining the road-crash reporting system. Increased crash reporting and availability of data from these two sources will provide road authorities with more reliable measures of injury outcome. (Auth)
Drink driving and traffic accidents in young people

The relationship between drink driving behaviour and rates of traffic accidents was analysed in a birth cohort of 907 New Zealand young people studied to the age of 21. Drink driving was significantly ($P<0.0001$) related to active traffic accidents in which the driver's behaviour contributed to the accident but was not related to passive accidents in which driver behaviour did not contribute to the accident ($P>0.15$). Those engaging in high rates of drink driving had rates of active traffic accidents that were 2.6 times higher than those who did not drink and drive. Further analysis suggested that much of this association was explained by confounding factors (and notably driver behaviour) that were associated with both drink driving and accident rates. After adjustment for confounding factors, those engaging in high rates of drink driving had rates of active accidents that were 1.5 ($P<0.01$) times higher than those who did not drink and drive. It is concluded that although the study findings support the view that the regulation of drink driving behaviour amongst young people is likely to contribute to a reduction in traffic accidents, to be fully effective attempts at regulation of drink driving also need to be accompanied by a similar level of investment in regulating other aspects of risky or illegal driving behaviour amongst young people. (Auth)

Elderly drivers and their accidents: the aging driver questionnaire

The Manchester Driver Behaviour Questionnaire (DBQ) was included as part of a questionnaire survey of 1989 drivers aged 50 or over. Previous research has differentiated three main types of aberrant driver behaviour: errors, lapses and violations. Each of these has different psychological origins, and different implications for road safety interventions [Reason et al., 1990. Ergonomics 33, 1315-1312. It has also been shown that, using a full age-range sample of drivers, reported violations were statistically associated with accident involvement, whereas errors and lapses were not [Parker et al., 1995a. Ergonomics 38, 1036-1048; Parker et al., 1995b. Accident Analysis and Prevention 27, 571-581]. Although factor analysis of the DBQ responses of this sample produced five factors, the original three-way distinction was preserved. However the pattern of relationships between factor scores and accident involvement was different. Relatively high scores on the error factor and the lapse factor were predictive of involvement in an active accident, while passive accident involvement was associated with high scores on the lapse factor. (Auth)

Explaining two-lane highway crash rates using land use and hourly exposure

This paper describes the estimation of Poisson regression models for predicting both single and multi-vehicle highway crash rates as a function of traffic density and land use, as well as ambient light conditions and time of day. The study focuses on seventeen rural, two-lane highway segments, each one-half mile in length with varying land use patterns and where actual hourly exposure values are available in the form of observed traffic counts. Land-use effects are represented by the number of driveways of various types on each segment. Hourly exposure is represented for single-vehicle crashes as the total vehicle miles travelled and volume/capacity ratio; for multi-vehicle crashes it is the product of the hourly volumes on the main highway and the roads intersecting it along the study segment. For single-vehicle crashes, the following variables were found to be significant, with a positive or negative effect as noted: daytime (06:00-19:00 h, negative effect), the natural log of the segment volume/capacity ratio (negative), percent of the segment with no passing zones (positive), shoulder width (positive), number of intersections (negative), and driveways (mixed effects by type). Good multi-vehicle crash prediction models had quite different variables: daylight conditions from 10:00-15:00 and 15:00-19:00 h (positive),
number of intersections (negative), and driveways (positive for all types). The results show that traffic intensity explains differences in crash rates even when controlling for time of day and light conditions, and that these effects are quite different for single and multi-vehicle crashes. Suggestions for future research are also given. (Auth)

How much do road accidents cost the national economy?
This paper presents estimates of how much road accidents cost the national economy, stated as a percentage of the gross national product (GNP). Official estimates of road accident costs from 1990 or later were compiled from easily accessible sources for twelve countries. Estimates of the gross national product were taken from OECD publications. On the average, the total costs of road accidents, including an economic valuation of lost quality of life, were estimated to about 2.5% of the gross national product. Excluding the valuation of lost quality of life, road accident costs on the average amounted to 1.3% of the gross national product. When valuation of lost quality of life is included, costs ranged from 0.5 to 5.7% of GNP. When valuation of lost quality of life is disregarded, costs ranged from 0.3 to 2.8% of GNP. (Auth)

Knee injuries in motor vehicle collisions: a study of the National Accident Sampling System database for the years 1979-1995
A detailed study of knee injuries recorded in the 1979-1995 National Accident Sampling System database maintained by the National Highway Traffic Safety Administration was conducted. Injuries to other body regions were also considered in order to illustrate the relative frequency of knee injuries. This study demonstrated that knee injuries constitute 10% of all injuries recorded every year. However, the majority of these injuries were of low severity (i.e. contusions, abrasions, lacerations) with an abbreviated injury score (AIS) of 1. Most knee injuries occurred following a frontal collision with no intrusion. The study also indicated most knee fractures occur in crashes where the vehicle velocity differences (AVs) were less than 45 kmph, with some occurring at AVs as low as 10 kmph. Serious non-fracture knee injuries (i.e. ligament tears) rated AIS 2 accounted for 20 out of every 1000 injuries and predominantly occurred at AVs below 25 kmph. In this study it was noted that women were more likely to experience a knee contusion than men. This study further suggests that knee impact scenarios have remained relatively constant over the years as the knee injury rates showed little variation. The rate of lap and shoulder belt use was lower in occupants who experienced a knee injury vs. the rate in the overall database and airbags were present in only a small number of cases. As this study largely included only vehicles without airbags it provides a good baseline for analysis of the influence of the airbag on knee injury trends in the future. (Auth)

Traffic accident statistics and risk perceptions in Japan and the United States
Several recent studies have concluded that Japan and the US have different risk cultures. This study examines the actual risk environments faced by citizens in the two countries, in the domain of traffic safety, as a possible source of differences in risk perceptions. The study contrasts traffic-accident risks from several points of view (e.g. car drivers, motorcyclists, bicyclists and pedestrians) and risk statistics (e.g. death rates, relative fatality risks, and accident lethality). Results clarify the traffic risks in the two countries and confirm their potential for explaining cross-national differences in risk perceptions. (Auth)
Uncertainty in incident rates for trucks carrying dangerous goods

This paper addresses the uncertainty associated with release and fire incident rates for trucks in transit carrying dangerous goods. The research extends the treatment of uncertainty beyond sensitivity analysis, low-best-high estimates and confidence intervals, and represents the uncertainty through probability density functions. The analysis uses Monte Carlo simulations to propagate the uncertainty in the input variables through to the resulting release and fire incident rates. The paper illustrates how we can combine information on accident and non-accident releases and fires to generate probability density functions for the total expected releases and fires per billion vehicle kilometres for trucks carrying dangerous goods. (Auth)

Visual risk factors for driving difficulty among older drivers

This study sought to evaluate associations between visual function and self-reported difficulty with driving tasks. Drivers (N= 384) between the ages of 55 and 85 were selected from ophthalmology practices and optometry clinics; three out of four of the sample had cataracts and the remaining were cataract-free. Information on driving exposure and difficulty was obtained via self-report. Visual functional status of all participants was measured with respect to acuity, contrast sensitivity, disability glare and useful field of view. Cognitive impairment was evaluated using the Mattis Organic Mental Syndrome Screening Examination. The results show a pattern of difficulty in high-risk driving situations among those with decreased visual acuity and contrast sensitivity, even after adjustments for age, gender, weekly mileage, and cognitive impairment. (Auth)

ACCIDENT SIMULATION/CRASH TESTS

Latest Euro NCAP supermini test results

Analysis and design consideration of an energy absorbing steering system using orthogonal arrays

An occupant analysis code SAFE (Safety Analysis For occupant crash Environment) is utilized to simulate and improve the crash performance of an energy absorbing steering system. The safety standard FMVSS 203 is adapted in the simulation and used in design evaluations. Segments and contact ellipsoids are employed in modelling the body blocks and the components of the steering system with SAFE. Spring-damper elements and force-deflection characteristics are utilized to model the energy absorbing components such as the plate and the polyacetal molding. The plate absorbs the impact energy through tensile deformation. Whereas, the polyacetal molding absorbs the impact energy through compression. The body block test is carried out to validate the simulation model, and real component tests are performed to extract the force-deflection curves. After the model is validated, the parameter study is carried out to evaluate the crash performance of the energy absorbing components. A performance measure is defined for the parameter study. Using the results of the parameter study and managing the orthogonal arrays, optimum design values of energy absorbing components are determined to minimize the occupant injury. (Auth)
Crash barriers

A look at research being carried out at the University of Birmingham's accident research centre that is helping to make cars safer. The centre has been building up a detailed and comprehensive database on road traffic accidents to cars and vans involving personal injury which happen each year within the West Midlands. Data is collected from the people involved and from an investigation of the vehicle in terms of its damage and deformation. (HL)

Development of a finite element model of the human neck subjected to high g-level lateral deceleration

Described herein is a finite element model of the human head-neck complex that is used to simulate the dynamics of the head and neck subjected to low and high lateral deceleration. The model which is intended to be used as part of an entire human body model consists of a rigid skull, the bony vertebrae modelled by shell elements, intervertebral discs modelled by solid elements and the most relevant muscles and ligaments modelled by membrane and spring-damper elements. Acceleration responses of the head obtained from experimental volunteer sled tests are used to validate the model for low g-level lateral deceleration. Additionally the corresponding results of the severest cadaver sled test are compared against the predicted response of the model subjected to high g-level acceleration. It is shown that this finite element model fulfils the requirements to be part of a finite element model of the entire human body regarding calculation time, stability and accuracy of the results. (Auth)

Dum and dummer

This article describes some of the current crash test parameters, particularly of the new 'lamp-post test', and traces the history of the European New Car Assessment Programme (Euro NCAP). The results from some of the models tested are described, and the involvement of car manufacturers and European governments in Euro NCAP is outlined. Future developments in dummy design is discussed, which may generate improved data on facia and steering wheel injuries. A text figure is included in the article giving the dates of previous tests and listing the models to be tested imminently. (RS)

Finite element crash analysis of framed structures by the adaptively shifted integration technique

In the present study, each member of a framed structure is subdivided with two linear Timoshenko beam elements at both ends and a cubic beam element based on Bernoulli-Euler hypothesis at the center. The adaptively shifted integration (ASI) technique is used only in the linear Timoshenko beam elements. The proposed model is applied to the explicit finite element analysis of the crashing behaviours of impulsively loaded framed structures considering the effect of large deformation by the updated Lagrangian formulation. Several numerical studies have been carried out in order to show the validity of the proposed numerical technique. (Auth)
Finite element modelling of skull fractures caused by direct impact

The paper outlines a finite element method for modelling skull bone fractures. The paper first describes a numerical failure criterion for cranial bone. This approach is then applied to a 3D detailed finite element model of the human head. Experimental skull fracture data from the literature are then simulated. The model provides good predictions of skull stiffness and fracture force. (Auth)

Interplay of factors influencing collapse modes in axially crushed tubes

The effects of various schemes of end constraints, heat-treatment, filler density and impact velocity on the behaviour of axially crushed tubes of different UD and D/t ratios are investigated. It is evident that these factors, individually or collectively, influence the collapse mechanism and hence determine the collapse mode. It follows that the total energy absorption capacity. The concertina mode represents the low energy mode whereas the multi-lobe mode represents the high-energy mode. The former is attributed to instability and/or geometric and loading imperfections. The latter mode, however, occurs as a result of stiffness enhancement. (Auth)

Structural stiffness, elastic recovery, and occupant inertial effects on measured door response in a laterally struck vehicle

This paper analyses the mechanisms of measured oscillations in the door velocity of a laterally impacted passenger vehicle and discusses their implications for modelling and side impact sled system design. Full-scale vehicle crash tests, barrier and vehicle load-deflection properties, and three finite element simulations are used to evaluate the relative contributions of structural stiffness, elastic recovery, and occupant and seat loading on the response of the door. Characteristic low frequency oscillations are measured in the door velocity during crash tests. but are identified as being the result of occupant and seat loading of the inner door and the resulting deformation rather than vehicle structural effects. It is concluded that the structural stiffness and elastic recovery of the vehicle structure can generate oscillations in the door velocity, but these oscillations are not independent of occupant inertia and thus should not be prescribed to a door in a computational model or component-level sled system. (Auth)

ENVIRONMENTAL CONCERNS

Efficient cleaning for the environment & everyone

In the third millennium, we need relief from the inter-fraternity rivalry between aqueous and solvent cleaning. Users also need relief from the complexity and cost of these types of cleaning. A new process has been developed to protect the environment, to clean parts, and it is simple and low cost to operate as well. This process (1) effectively cleans small complicated steel parts, (2) allows cleaning of parts on a continuous or batch basis, (3) substitutes the force from ultrasonic transducers for cleaning chemistry, (4) uses DI water with no rust preventives, and (5) allows recovery of water without significant contamination by soils. (Auth)
Environment-friendly automotive technologies in Korea

As environmental concerns are getting increasingly important, world's automobile manufacturers are confronting mounting pressure to increase the fuel efficiency, highly related to global warming causing CO2 emissions, and to reduce the exhaust emissions. In order to accomplish this purpose, automotive companies in Korea also have been striving to develop many advanced technologies such as lean burn engine, direct injection gasoline engine (GDI), direct injection diesel engine, continuously variable transmission (CVT), vehicle lightweighting, lower emissions vehicle, recycling, and various alternative fuel vehicles (AFV's). AFV's include flexible fuel vehicle (FFV) on methanol, natural gas vehicle (NGV), LPG vehicle, hydrogen vehicle, electric vehicle (EV), hybrid electric vehicle (HEV), and fuel cells vehicle. (Auth)

Environmentally-conscious cleaning for the millennium

In the third millennium, we need relief from the inter-fraternity rivalry between aqueous and solvent cleaning. A new process has been developed to protect the environment and to clean parts, as well. This process (1) effectively cleans small complicated steel parts, (2) allows cleaning of parts on a continuous or batch basis, (3) substitutes the force from ultrasonic transducers for cleaning chemistry, (4) uses DI water with no rust preventives, and (5) allows recovery of water without significant contamination by soils.

The research and development of ecomaterials in Taiwan

Taiwan's booming industrial development within the last 40 years have not only raised the living standards of its people but also aroused their environmental awareness. The latter is an important driving force for environmental improvement activities in Taiwan. A balance between economic prosperity and a clean environment is essential for pursuing sustainable development. It is found that advanced materials and related technologies are not only the driving forces for industrial developments, but are also the essential means for solving environmental problems. Thus, it is necessary for Taiwan to develop and to effectively use these environmental materials and technologies in order to achieve a balance between economic growth and environment protection. (Auth)
GENERAL

The BMW Z8: Part 1-Concept body, safety, electrical/electronic systems

As the new kid on the block among the super sports cars, the Z8 is aimed at a small group of customers who have very high demands and wish to combine "the ultimate driving machine and the ultimate design with exclusivity, safety, reliability and quality". The latest engineering, such as the aluminium structure and aluminium exterior skin, the high performance power train and the sophisticated sports chassis, the stability control system, the high performance braking system and the tyres with emergency features go together to make the Z8 an extraordinary sports car. A full range of equipment with a hardtop, telephone, audio and navigation system, attention to detail and lots of aluminium in the interior combined with high quality leather underline the exclusivity of the Z8. Part 2 follows in issue of the ATZ: engine, powertrain, chassis, acoustics, quality and repair procedures.

ATZ 6/2000 01JUN2000, p 2 (7 p, 6 fig)
Index Terms: SPORTS CAR/ BMW/ DESIGN/ ALUMINIUM/ SAFETY/ POWERTRAIN/ CHASSIS
Doc No155115
(in GERMAN and ENGLISH)

Bodyshell and passive safety

With the development of the body-in-white for the C-class saloon, the engineers at the Mercedes Technologie Center (MTC) in Sindelfingen also laid the foundation for a family of models with a variety of different bodies. For this reason, the aim was not only to make further progress in the fields of safety, strength and lightweight construction, but also to take into account the large number of differing requirements which future body versions will make on the basic body design.

ATZ 7-8/2000 01JUL2000, p 7 (4 p, 2 fig)
Index Terms: BODY-IN-WHITE/ SALOON/ BODY DESIGN/ SAFETY/ CONSTRUCTION
Doc No155171
(in GERMAN and ENGLISH)

Insight: How to 'read the driver'

This article presents contrasting approaches to the problem of the interaction between racecar drivers and the technical teams. The article does this in the form of a series of edited comments from ten well known race engineers.

Racecar Vol 10 No 9 01OCT2000, p 28 (7 p, 0 fig, 0 ref)
Index Terms: VEHICLE DEVELOPMENT/ RACECAR DATA
Doc No154660

Insight: ... in a round hole

This article describes the building of a state of the art Grand Prix circuit within the existing Indianapolis Motor Speedway circuit. The goal of the circuit designer was to offer a balance between power and handling, with design parameters being geography, topography, infrastructure, spectator view and available space. Consideration has been given to passing opportunities inherent in the circuit design. The existing oval section of the course will be restricted to 50 foot width. The article focuses on the way in which safety issues have been addressed, particularly the design of gravel traps.

Racecar Vol 10 No 9 01OCT2000, p 36 (5 p, 1 fig, 0 ref)
Index Terms: CIRCUIT DESIGN/ FORMULA 1
Doc No154661
Insight: Q tips

With overtaking in current Formula 1 cars being so difficult, the incentive to gain a good grid position is significant. Despite increased FIA regulation, qualifying cars are still set up. The article suggests three main ways of optimising a car for qualifying: set the handling for a three lap run on the tyres (with an almost empty tank); set the aerodynamics for the best lap time rather than for top speed, overtaking or preventing overtaking, and fit components that have a twelve-lap life to gain power or weight. The article gives examples of lower weight components that may be used for a qualifying car. But as the overall weight of the car is controlled, the savings translate into a more effective positioning of the car's mass. (RS)

Insight: Shift working

This article describes a new way of achieving sequential gearshifting developed by New Zealand engineer Paul Goatley. The Goatley transmission was conceived as an adaptation of a standard gearbox to enable fast sequential gear changes. The principle is to utilise multiple mini clutch packs to engage the drive between a gear and the shaft, in place of synchro-hubs and cones. Specially adapted adaptor hubs are used with an internal spline engaging with the externally splined main shaft. The adaptor hub is designed and machined with annular recesses into which the clutch packs and hydraulically actuated slave pistons are fitted. The configuration is shown in two figures. Ratio changes occur when one gear is simultaneously engaged to the hub while another is released.

The system can be made more sophisticated by the use of electronic control systems operating the solenoid valves. The article summarises the unique features of the Goatley transmission. The article sees applications not only in motorsport but in cars, trucks and heavy transport, machinery and even in vehicles used by handicapped people. Early research has indicated that this technology could form the basis of most future transmissions. (RS)

The new BMW 330i

Previous BMW 3 Series models established this car's character as a sporty, dynamic compact sedan with a high-value, emotionally charged appearance. Thanks to the logically consistent layout of the BMW 330i's drive train with its dynamic responsiveness that ensures objectively superior road performance, this model is redefining the top position in this market segment. The car's appearance, acoustical tuning and agility convey the exceptional dynamism that makes it the "ultimate driving machine" - whether it is equipped with a manual or automatic transmission. The new drive train layout and detailed functional optimizations have made it possible to reach the demanding goals set in the area of dynamism while simultaneously reducing fuel consumption. Awareness that the exhaust emission levels are extremely low also adds to the pleasure of environmentally acceptable driving. (Auth)
The new Mercedes-Benz C-Class

The story of the C-class and therefore the entry by Mercedes-Benz into the new medium class market segment began in 1982, with the introduction of the 201-series - known as the "Baby-Benz" - which had a seminal effect on German automobile engineering for almost eleven years. The second generation, the 202-series, entered the market in 1993 and continues to set standards in its segment to the present day. The lines concept introduced with this series, a marketing innovation which has meanwhile been copied by almost all automobile manufacturers, saw the start of an unprecedented product offensive. With the market introduction of the 203-series saloon, which celebrated its premiere in March 2000 after a development time of approx. four years and an investment of 1.4 billion Euro, DaimlerChrysler is continuing the success story of the C-class. The attractive design with a modern interpretation of the four-eyes face immediately reflects two of the most important characteristics of the new C-class: dynamism and elegance. With newly-developed suspension technology, powerful engines and the latest technical innovations the saloon combines the typical Mercedes values of the greatest possible safety, the highest quality, exemplary comfort and absolute reliability. (Auth)

The new Peugeot 607

With the 607 - the successor to the 605 - Peugeot aims to more than double its market share in the executive car sector in Europe: it plans to sell 45,000 vehicles in 2001, giving the company a market share of 4%. The car is packed with state-of-the-art technology, and a special feature is that all HDI versions are now fitted with a particle filter as standard. (Auth)

Race shop: Lotus position

This article traces the recent re-emergence of Lotus as a racing name, under its ownership by Proton. Following the death of Colin Chapman in 1982, Team Lotus carried on in Formula 1 until the end of 1994, when it was disbanded. In the early 1990s the Lotus reputation was maintained by its engineering division alone until the launch of the Elise model in 1995. In 1997, Lotus Racing, a team based on a nucleus of ex-Team Lotus personnel, produced a new GT1 racecar based on the new Elise. Lotus Motorsport was established in 1999 to promote the Elise as a competition car. The article continues by describing in detail the modifications to the racing version of the Elise. (RS)

Tractors 1999/2000

Standard tractors remain the key machines in agricultural mechanisation, and at the same time have outstanding importance for the future of the world's food supply. The functions that they have to fulfil are constantly increasing, ranging from conventional machinery in growth markets like India to high-tech applications in saturated markets like western Europe. This article reviews the state of the art in tractor technology. (Auth)
**V-angles: Data 'self-analysis'**

This article summarises and comments on an SAE paper (2000-01-1628) - itself a condensed doctoral thesis - presented at a vehicle dynamics conference. The paper addressed the challenge of processing racecar data. In essence, attempting to computerise the process of what an expert will look for in the data.

The paper focused on steer angle, lateral g and throttle. These variables are 'filtered' to provide a smooth heavily damped baseline. Comparisons of the differences in the three resulting traces gives the amplitude and durations of peaks. These events of interest are then further analysed through expert systems software. (RS)

**VEHICLE DESIGN AND PERFORMANCE - SPECIFIC MODELS**

**156 proves that less can be more**

This is a review of the 1.6 litre version of the Alfa Romeo 156. The review regards this car as a compact executive at a small hatch price. The equipment level is the same as other 156 models, but priced under both Focus and Astra 1.6 models.

The steering and handling is sharp, with a sporty engine. The cabin is not as high class as the Audi A4, and the ride is bettered by the BMW 3-series, but the reviewer recommends the package on value for money grounds. The article includes a table summarising the performance data. (RS)

**A2's a design of the times**

This is a review of Audi's new MPV A2. Whilst not being a true A class competitor, the A2 is innovative. It features an all aluminium body fitted to space frame lowering trim weight, allowing smaller engines and reducing emissions (and hence road tax).

The engine will be a 1.4 litre petrol unit with a 1.4 three cylinder diesel giving a major increase in fuel economy to follow in 2001. The A2 is well made with good safety features. The article feels that the car will be chic, and fashionable as it will be in short supply. There is a small table summarising the model range and performance. (RS)

**Ageing Micra remains teacher's pet**

This article reviews the revised Nissan Micra. Exterior styling changes make the Micra appear lower and wider, and the dash is redesigned. The new 1.4 litre engine has its maximum torque at a much lower 2800rpm compared with the old 1.3 unit. Fuel consumption is also improved.

Despite the revisions, though, the review still finds the passenger and boot space disappointing. However the car may well continue to appeal to the learner market. There is a small table summarising the models' performance. (RS)
Automobile Abstracts

October 2000 (31/10/2000)

All Swedeness and might

This is a review of Volvo's new compact executive saloon offering, the S60. It has sporty looks having a family resemblance with the C70 and sharing design cues with the S80, but a tapered roof line gives a coupe-like profile. The sporting feel has been carried over into the interior styling, without losing its practical and functional feel.

The article praises the practicality of some of the stowage features, but finds the interior space lacking compared with the larger Volvos especially in rear headroom. Under the bonnet is a range of three sporty 5 cylinder turbocharged units - the entry level claims 0-62mph in 8.8 seconds, top speed 140mph. Two suspension set ups will be offered. In line with its image, there is a wide range of standard safety features.

The article is impressed by the initial impact of the car, claiming that it has the looks, performance and safety features to compete. With the entry level model undercutting the BMW 320i SE due in 2001, the clincher could be its price. There is a small table summarising the model range and performance. (RS)

What Car? October 2000 01OCT2000, p 16 (2 p, 1 fig, 0 ref)
Index Terms: VOLVO/ VEHICLE DESIGN/ VEHICLE DEVELOPMENT
Doc No154684

Audi A2

Road & Track October 2000 01OCT2000, p 37 (1 p, 2 fig)
Index Terms: AUDI
Doc No154936

Audi turns up the diesel heat

Audi's new V6 TDi powered A6 quattro Sport is now uprated to 180bhp developing 273lb ft torque. Whilst the performance has improved accordingly, the fuel consumption has fallen by 5mpg. (RS)

What Car? October 2000 01OCT2000, p 33 (1 p, 0 fig, 0 ref)
Index Terms: AUDI/ VEHICLE DEVELOPMENT/ ENGINE PERFORMANCE
Doc No154697

The best Alfa ever (Alfa Romeo 147)

Autocar No 42 18OCT2000, p 24 (6 p, 15 fig)
Index Terms: ALFA ROMEO
Doc No155099

Between a rock and a soft place

A review of the Mazda Tribute 4x4 soft-roader. The article sets the Tribute in context by describing how its approach differs from Ford's Maverick. The Tribute is a large unit for a vehicle designed to compete in the CR-V, Freelander market. The body roll is well controlled with good ride and first-rate straight line stability. Steering feel and accuracy is excellent, with impressively strong, progressive brakes.

The weight of the vehicle, however, makes overtaking pedestrian despite the 200bhp, 200lb ft 3.0 litre V6. True off-road performance is not impressive, soft sand and rocky river bank defining its limits. Overall, the Tribute is smooth and refined with car-like agility, but not suitable for anything more difficult than forest tracks. (RS)

Car October 2000 01OCT2000, p 120 (3 p, 0 fig, 0 ref)
Index Terms: MAZDA/ VEHICLE DESIGN/ VEHICLE DEVELOPMENT
Doc No155246
Bigger is better for Civic (Honda Civic)

This article reviews the new BMW 330i. An increase in the engine capacity by 200cc has increased the power from 193 to 231bhp, with mid-range torque increased from 206 to 221lb ft. The torque curve is spread more evenly, which leads to more relaxed cruising, overtaking and in-town flexibility. The engines still retain their sporting feel: both saloon and coupe achieve 0-62mph in 6.5 seconds, with top speeds limited to 155mph.

Equipment levels have been enhanced, with high safety levels. Pricing has been left as that for the 328i. There is a small table summarising the performance. (RS)

The BMW Z8

As the new kid on the block among the super sports cars, the Z8 is aimed at a small group of discerning customers who have the highest demands and wish to combine "the ultimate driving machine and the ultimate design with exclusivity, safety, reliability and quality". The very latest in engineering, such as the aluminium structure and aluminium exterior skin, the high performance powertrain and the sophisticated sports chassis, the stability control system, the high-performance braking system and the tyres with emergency "Run-Flat" features go together make the Z8 an extraordinary sports car. A full range of equipment with a hardtop, telephone, audio and navigation system, attention to detail and lots of aluminium in the interior combined with high quality leather underline the exclusivity of the Z8. (Auth)

Cheap and chair-full

This article tests and compares two midi-MPVs: the Daewoo Tacuma CDX and the Kia Carens 1.8 GSX 5st. The introductory section compares prices, occupant comfort and the flexibility of their load spaces. The feature specification and equipment levels are compared and discussed.

The article includes two comparative figures showing load space configurations, cabin interior and external views. The summaries find the Daewoo an attractive buying proposition, whilst its drive is dull and the interior is not so well thought out as some of its European rivals. The Kia wins on price, ride, boot size and warranty, but lacks versatility and the cabin quality is poor. The article recommends the Daewoo Tacuma over the Kia Carens, and provides a table comparing the two specifications. (RS)
Corsa hots up supermini war

This article reports on the first drive of the new Vauxhall Corsa. The Corsa has been Vauxhall's most consistent performer in Europe taking 30% of supermini sales. Vauxhall have aimed to retain the Corsa's appeal to the female market and increase its appeal in the 'driver's car' sector.

The bonnet height has been lifted to allow fitment of bigger engines; the screen's rake has been increased to give a more sporty look; the cabin has been widened by just over 3 inches at shoulder height to enhance the big-car feel, and exterior styling has been made more interesting. A stiffer body improves ride and reduces noise; a redesigned suspension improves comfort and control, and there are more safety features. There will be six engines - four petrol, two diesel - all meeting Europe 2005 emissions. There will be an optional Easytronic automatic giving a choice of full automatic or Tiptronic-style shifts.

The article praises the ride and handling, the higher design values, and the powertrain. The review feels it is well-rounded, roomier and better looking than the Ford Fiesta, and one of the best cars Vauxhall have made. There is a small table summarising the model range and performance. (RS)

Custom manifold blocks

This article considers the design of the Scarab heavy-duty suction road sweeper. The sweeper system runs off an axial pump driving the sweeper's suction fan, and a gear pump powering the brushes and hopper/door rams. Such compact hydraulic systems allow the vehicle's size and weight to be minimised. (RS)

Diesel is a slow-burner

This article reviews the Renault Scenic RX4 1.9 dCi. With this model, Renault attempts to transform Scenic's family image through rugged styling. The 1.9 litre turbodiesel is, however, outperformed by the 2.0 litre petrol version, except in fuel economy. Furthermore, suspension changes to allow four wheel drive have undermined the ride and handling performance.

The conclusion of the reviewer is that the RX4 is more economical than the petrol version, but is a more compromised vehicle at a higher cost. There is a table summarising the performance. (RS)

Fab new Mini is ready, steady, go (Mini)

Car November 2000 01NOV2000, p 24 (2 p, 5 fig)
Index Terms: MINI
Doc No155391

Fiat Brava 1.4 - 1.6

Revue Technique Automobile No 631 01SEP2000, p 65 (48 p, 84 fig)
Index Terms: FIAT
Doc No154952
(In FRENCH)
Head-onist

A review of the new Lexus LS430. The LS430 retains the overall length and basic powertrain and suspension set up, the rest of the car is new. The wheelbase has been increased resulting in more interior space. The engine is an updated and enlarged 4.3 litre version of the V8, whose power remains 290bhp, but torque is increased by 20lb ft to 320lb ft. The transmission is an electronically controlled, five speed automatic.

The interior appointment and feature level is considerable, which the article describes. However, the exterior styling appears to be over-restrained and derivative to the reviewer, who feels that the Lexus is impressive but unemotional. (RS)

Heavy metal

This article reviews the driving experience of a 10x6 Liebherr crane (LTM1100/2). This is Liebherr's latest five axle all terrain mobile crane, powered by their own D 9408 V8 engine offering 544hp and developing 2490Nm of torque. This engine is Euro 3 compliant and is electronically controlled allowing the latest fully automatic ASTronic gearbox from ZF to be used. A separate motor powers the crane, whose lifting capacity is 100 tonnes. The travelling weight is 60 tonnes, and the vehicle can be operated with either three or four of the axles driven. The reviewer goes on to describe his impressions of the vehicle from
behind the wheel.  (RS)

Hello to a good buy (Skoda Octavia)

A hit and Niss affair (Nissan Maxima QX)

Honda Civic

Hot oil cooks up ultimate Golf (VW Golf GT TDi 150 BHP)

Ibiza’s more Golf GTi than the VW

Icon and on and on (Impreza Turbo)

The imprezionist

Insight: Top secrets

The article goes on to describe the development of the body, giving a figure showing a finite element analysis of the torsional stiffness of the integral roll cage. The sump was also
Automobile Abstracts  October 2000 (31/10/2000)

used as a stressed member. Aerodynamic development is discussed, describing the different aerodynamic requirements in Japan, Germany and Britain. The problem for Nissan was achieving one aerodynamic package to use in all counties. (RS)

Racecar  Vol 10 No 9  01OCT2000, p 14 (9 p, 1 fig, 0 ref)
Index Terms: NISSAN/ VEHICLE DESIGN/ VEHICLE PERFORMANCE
Doc No154653

Jaguar joins the aluminium elite

The X350 Jaguar, due to be launched next year, will be the first Jaguar to make extensive use of technology developed by Ford's North America Aluminium Intensive Vehicle programme. Aluminium will be used in place of steel for the main structure and closure panels of the car, and, self-piercing rivets, adhesive bonding and clinching/hemming joining techniques used. (HL)

Professional Engineering  Vol. 13, No. 17  20SEP2000, p15 (1 p, 1 fig)
Index Terms: ALUMINIUM/ FORD/ JAGUAR/ NEW MODELS
Doc No155256

King of the road and track (BMW X5)

Car  November 2000  01NOV2000, p 44 (1 p, 5 fig)
Index Terms: BMW
Doc No155399

Land of the vee (Freelander V6)

Autocar  No 38  20SEP2000, p 48 (4 p, 11 fig)
Index Terms: LAND ROVER
Doc No154943

Landcruiser reclaims its ground

A review of the Landcruiser Colorado's mild restyle. A new front grille and headlights, and standard side steps keep the imposing exterior look, while a redesigned dash and interior trim simplify and brighten the interior. (RS)

What Car?  October 2000  01OCT2000, p 32 (1 p, 0 fig, 0 ref)
Index Terms: TOYOTA/ VEHICLE DESIGN
Doc No154696

Lexus 4X4's set to fight dirty (Lexus RX300)

Autocar  No 42  18OCT2000, p 30 (2 p, 9 fig)
Index Terms: LEXUS
Doc No155100

Lexus shifts to auto

A review of the Lexus IS200 automatic finds the gear changes to be impressively smooth, whilst only having four gear ratios. (RS)

What Car?  October 2000  01OCT2000, p 33 (1 p, 0 fig, 0 ref)
Index Terms: LEXUS/ AUTOMATIC TRANSMISSIONS
Doc No154700

A life less ordinary

This is an extended review of the new Ford Mondeo. The article sets the new vehicle in the context of Ford's mission to be dependable and contemporary, and to provide driving quality. The car has a new body, with a longer wheelbase (evident in the rear legroom), a wider track, and a substantially new suspension and steering gear.

The article discusses the new styling, which has a 'Passat-like reserve', but with a robust and tailored look. The test car's engine - an all new 16 valve, 2.0 litre (145bhp) unit designed by Mazda - is tuned for torque, and is smooth throughout the rev range. The
Automobile Abstracts  October 2000 (31/10/2000)

steering, ride and handling performance on a variety of surfaces was experienced and is discussed. (RS)

Car  October 2000  01OCT2000,  p 82 (10 p, 0 fig, 0 ref)
Index Terms: FORD/ VEHICLE DEVELOPMENT/ VEHICLE DESIGN
Doc No155242

Lion’s new SRI just too tame

This article reviews Peugeot's latest sporting car, the 406 SRI. The article compares the performance of the SRI versions of the 406 saloon and estate favourably against the 405 SRI, but feels they lack 'raw edge'.

The refinement and vibration control is good, with a firm ride and less body roll. The equipment level is also reasonable, but the reviewer feels that the car lacks excitement. There is a small table summarising the performance. (RS)

What Car?  October 2000  01OCT2000,  p 23 (1 p, 1 fig, 0 ref)
Index Terms: PEUGEOT/ VEHICLE DEVELOPMENT/ ENGINE PERFORMANCE
Doc No154688

Lupo TD cuts a dash in the city (Volkswagen Lupo TDI PD Sport)

Car  November 2000  01NOV2000,  p 37 (1 p, 1 fig)
Index Terms: VOLKSWAGEN
Doc No155396

The M-pire strikes back

This is an extended review of the new BMW M3. The article first gives a summary of the history of the M-series marque, setting the new M3 in the context of its predecessors. The new styling is discussed. The developed 3245cc six cylinder engine has power output raised from 321 to 343bhp, with the rev limit raised to 8000rpm. Torque is also increased, developing 269lb ft at just under 5000rpm. With anticipated acceleration down to 5.2 seconds (0-62mph) and in-gear acceleration between 50 and 75mph at 5.4 seconds, the reviewer expects this to be the quickest M-series car built by BMW.

Powertrain improvements include a new variable differential. The latest dynamic stability control system will be fitted, with ABS and traction control. Suspension geometry has been revised, with stiffened and strengthened subframes. The reviewer anticipates that the balance of performance and interior luxury will revive the M-series appeal. (RS)

Car  October 2000  01OCT2000,  P 94 (9 p, 0 fig, 0 ref)
Index Terms: BMW/ VEHICLE DEVELOPMENT
Doc No155243

M3 flaunts it muscles (BMW M3)

Car  November 2000  01NOV2000,  p 23 (1 p, 5 fig)
Index Terms: BMW
Doc No155390

Majority decision

This article reviews the Foden 4000 through the in-service experiences of three operators. The article gives some of the background history of the Foden 4000 before giving comparative profiles of the three operators in tabular form.

Tyson H. Burridge of Distington, Cumbria, has been disappointed with the Foden. Engine reliability was the major problem coupled with poor fuel economy.

Terry Seaman of Redisham, Suffolk, has standardised on Foden since the early 1980s. Seaman has had excellent long-term service from the 4000, and still has an eleven year old model in service.

33
Tweddle Trans of Hartlepool, Co. Durham, runs one Foden 4000 as an owner-driver. Tweddle has received good service from the Foden, although he feels some parts are expensive, but would invest in another.

Each operator profile includes a photographic figure showing some of the problems areas experienced or modifications made to their trucks. The conclusion comments on some of the problems and plus points of the 4000 series, summarising owner experiences in a detailed figure. There is also a figure comparing the Foden 4350 with its main test rivals.

Malayse afflicts Wira (Proton Wira 1.6 LUX)

The DaimlerChrysler subsidiary EvoBus introduced the Cito at the International Commercial Vehicle Show two years ago. This was not only a completely new vehicle, but it has opened the door to a new bus class: it is called the Midibus, and it is designed for use in narrow city centres. It closes the gap that existed hitherto between the 12-m city bus and the minibus. Meanwhile the Cito has established its market position. (Auth)

Mercedes pumps diesel into the lap of luxury

This reviews the Mercedes-Benz first diesel limousine, the S320 CDi. The car is powered by a six cylinder 3.2 litre turbodiesel, developing 470lbft of torque from 1800 to 2600rpm with 0-60mph taking 8.8 seconds. The reviewer notes the smoothness and quietness of the engine in particular. The economy out of town reaches 47mpg, where the air suspension contributes to a superb ride. There is a table summarising the model's performance. (RS)

Mission illogical

A review of the latest four speed automatic in the Renault Espace 2.0 litre. The reviewer finds it more awkward than adaptive as an automatic system, but the vehicle returns a combined fuel economy of 30.1mpg. (RS)

Muck and class

This article is a report of a twin test between two four wheel drive off-road estates: the Audi allroad 2.7 T and the Volvo V70 Cross Country SE. An introductory section describes each vehicle's four wheel drive and ride height control systems. The vehicles' performance on urban roads, motorways and on farm tracks is compared. The performance and stopping distances are also compared. Cabin room and load carrying capabilities are compared, as well as purchase and lease costs.

The article includes two comparative figures showing cabin interior, load space, front seating together with on and off road pictures. In summary, the article finds the Audi
allroad to have good refinement, interior quality and versatility, but has a higher price, a smaller boot and slightly less practicality. The Volvo is found to have a large loadspace, good comfort, practicality and a competitive price, whilst the cabin is bland, the ride, handling and residual values are poor. There is a further table comparing the two vehicles' specifications. The article recommends the Audi, despite the higher cost, as it is more versatile, refined and better on road. (RS)

New Cabstar for UK
Nissan has launched a Cabstar E for the UK, with more powerful engines, increased cab space and better manoeuvrability. The two models in the range - the 2.7 litre turbo diesel 90, and the 3.0 litre direct injection turbo diesel 110 - are described, with their detailed improvements. (RS)

New engines make five even more alive (BMW 5-Series)

The new Ford Mondeo; the full story
This special section looks at the development of the new Ford Mondeo. Includes articles on the use of Ford's C3P computer program that reduced development time, engine development, safety features, ride and handling, space efficiency and quality. A listing of organisations involved in the supply of materials systems and components is also included. (HL)

New power for Espace
The Renault Espace has been given a number of revisions including new Proactive transmission, a new common rail diesel turbodiesel engine and all round disc brakes. The Espace also has a maximum four star NCAP crash rating. (HL)

Newcomers: Hailed Caesar
A review of the Nissan Maxima 3.0 SE+. The reviewer finds the car calm, competent and smooth, but at the expense of excitement and involvement. In this respect the reviewer sees the car handicapped by being priced into the sector occupied by Mercedes C240, BMW 520i SE, Audi A6 1.8T quattro and Volvo S80. Nevertheless, the car has a redesigned body, rear suspension, more interior space and a choice of V6 engines, and with more refinement and stability than the previous model. (RS)

Newcomers: If it ain't broke
The Jaguar XK8 for 2001 has been left more or less the same as the previous model year, but with some useful changes. The review starts by praising the new airbag system, which modifies their firing force depending on the size and position of the occupant, and the severity of a crash. There are also new sportier seats, more flush-fitting fog lamps, rear
Automobile Abstracts  October 2000 (31/10/2000)

lamp improvements, a deeper rear bumper, and the interior has a better phone.

The car still provides a good ride with well controlled road noise, but the engine and chassis still put the XK8 in the first division of grand tourers. There is a small figure summarising key points. (RS)

Index Terms: AIRBAGS/ JAGUAR/ VEHICLE DEVELOPMENT
Doc No155239

Newcomers: In good company

A review of the Toyota Avensis 2.0 VVT-1 CDX. The reviewer finds the Avensis easy to drive, with the controls well placed and the handling predictable. The visual changes amount to wrap-around headlamps, a wider grille, bigger tail lamps, deeper-set fog lamps and chrome. The new engines are more interesting, including a refined and torquey common rail diesel, the 1.8 VVT, an all new 2.0 litre direct injection petrol unit plus a new 1.6 VVT. The suspension has been improved, giving a more assured feel. (RS)

Index Terms: TOYOTA/ VEHICLE DEVELOPMENT
Doc No155240

Newcomers: Moneyed, too tight to mention

A review of the Volkswagen Lupo TDI. The three cylinder diesel engine has 75bhp and develops a more impressive 144lb ft of torque - and is very frugal. The reviewer finds the car noisy at speed, but handling is fun, and steering direct with a tendency to understeer. The review, however, finds the car overpriced. There is a small figure summarising the key data. (RS)

Index Terms: VOLKSWAGEN/ VEHICLE DEVELOPMENT
Doc No155273

Newcomers: Nobles and whistles

This article reviews the Noble M12 GTO. Summarising the competition, the article feels the M12 GTO is set against the awaited Lotus M250. The M12 uses a heavily modified Ford Duratec V6 engine, which develops 168bhp. Weighing 980kg, the M12's twin turbochargers, air-to-air intercooler, reprofiled cams and uprated pistons, rods, ECU and exhaust generate impressive acceleration.

The article finds the styling as more assured and credible than the M10. The reviewer enjoys the noise of the car, the performance, ride and handling, claiming Ferrari-beating performance for half the price. A small figure summarises the key data and price. (RS)

Index Terms: NOBLE/ VEHICLE DEVELOPMENT
Doc No155271

Newcomers: Precious little

This article reviews the new Audi A2, described as having 'revolutionary forward looking technology'. Audi have redesigned the aluminium space frame, first introduced in the A8, to cope with production targets of some 60,000 per annum. Audi claim the car weighs just 895kg, but equipment levels are still high - including four airbags.

The interior design receives high praise from the reviewer: it puts 'the A-class to shame'. The interior provides surprisingly good accommodation, partly due to Audi's 'space floor concept'.

The engine on the test car was a 16 valve, 1.4 litre petrol (75bhp, 92lb ft). The article found it quite noisy, and slow off the mark, but with acceleration from 60 to 80mph feeling more
Automobile Abstracts October 2000 (31/10/2000)

lively due to the aerodynamics. The article finds the steering good, but the ride a serious letdown. The article includes a small figure summarising the key data and price. (RS)

No 'lac of new tech

A recent briefing was set for the development of pace cars for the Motorsports industry. This brief was simply to produce a pace car which could stay ahead of the race cars and maintain a speed of 150mph, in order to enable it to reach any incident in moments. This has resulted in the Cadillac Seville STS, of which, it is claimed a road-going version will be developed to rival the BMW M5.

The new Cadillac, in it's pace car variant, is equipped with an improved Nothstar V8, which is capable of producing 350 bhp with 243lb ft of torque. The CVRSS (Continually Variable Road Sensing Suspension) system, which is currently in the Seville, has been reprogrammed with a change in parameters and this, coupled with a hardware/software upgrade for the Stabiltrak 2.0 stability system, appears to produce a much more aggressive ride. Another modification of the vehicle is that the GM Hydra-matic 4T80E transmission has also been reprogrammed so that it's performance algorithms are more relevant to circuit driving conditions.

Cadillac plans to introduce a significant advancement in their product line every year for the next ten years, as part of their profile raising plans in Europe, an area of which includes their three year commitment to Le Mans. (MDS)

Off-road, on budget (Hyundai Santa Fe)

Old smoothy fights back (Jaguar XK8 Coupe)

Omega whips up the horses

This article reviews the Vauxhall Omega 2.2. Whilst the power increases only 8hp over the 2.0 litre version, there is extra pulling power (151lb ft versus the 2.0 litre's 136). The review finds the car spacious, comfortable and refined, if not particularly desirable. (RS)

Passat and Octavia reveal fresh faces

The article shows the face-lifted Volkswagen Passat and Skoda Octavia. The Passat receives a new front-end design, and at the rear a new boot lid, lamps and bumper. There is a new four valve version of the 2.3 litre V5 engine in the range, with the existing engines receiving power uprates.

The Skoda Octavia has a new grille and front bumper, with some interior cosmetic changes and more rear legroom. Both models are expected to be launched at the Birmingham motor show. (RS)
Pop cultured
An extended review of the new Vauxhall Corsa. The article first sets the context of the success of the existing Corsa. In terms of styling, the Punto-like rear is felt to be a major improvement. The roofline is tauter, and bigger wheels, longer wheelbase and wider track give a more solid appearance. The interior has a higher quality feel, despite some carry over Astra switchgear. Storage solutions are good, and the driving position is roomier.

A stiffer structure has allowed dynamic improvements to be made to the ride and handling. Steering has been made speed sensitive. The range of gearboxes available is discussed, together with the engine range. (RS)

Porsche Carrera GT
Auto Motor Und Sport No 21 04OCT2000, p 14 (5 p, 10 fig)
Index Terms: PORSCHE
Doc No155110
(In GERMAN)

QX has minimal appeal (Nissan Maxima QX)
Car November 2000 01NOV2000, p 47 (1 p, 2 fig)
Index Terms: NISSAN
Doc No155403

Santa’s goodies sleigh rivals (Hyundai Santa FE V6)
Autocar No 38 20SEP2000, p 22 (2 p, 10 fig)
Index Terms: HYUNDAI
Doc No154939

Saving the wood for the trees
This article reports a test of the Honda Insight. This is Honda’s first attempt at an economical, ecologically friendly hybrid car. It achieved 95.6mpg on a 65 mile touring test. A 30 mile part suburban and part motorway run gave over 60mpg, and stop-go town driving gave 45-50mpg.

The power units consist of a 1.3 litre three cylinder petrol engine and an electric motor providing an additional 8bhp for acceleration. The Insight produces 80g/km of CO2 - less than any other production car. The weight, drag and friction reduction measures employed in the Insight are described.

The performance, ride and handling are discussed, together with the car’s feature specification. The article applauds the vehicle’s economy, but notes the impracticality and ownership costs. (RS)

Seat’s baseline ace (Seat Leon 1.4S)
Autocar No 39 27SEP2000, p 31 (1p, 4 fig)
Index Terms: SEAT
Doc No155386
The second coming

This article is an extended review of the Subaru Impreza WRX. Firstly, the article comments on the styling changes - in particular the controversial new headlamps. The dynamics of the car have been improved - handling, grip, refinement and driveability - and the engine and four wheel drive layout remain intact. Both the saloon and hatchback are bigger, being based on extended platforms with improved torsional rigidity. The new suspension performance receives special praise from the reviewers.

In the UK, a 2.0 litre turbo (215bhp) will be available, along with a 121bhp naturally aspirated version and a 1.6 litre 92bhp entry level unit. The engines improve emissions performance with reduced noise. As before, the transmissions will be four speed automatic or five speed manual, but the shift quality has been improved. The powertrain as a result is described as being smoother, more powerful, linear and flexible. (RS)

Smaller motors give V the victory

This article reviews the Volvo V70 estate. In the form of 140 and 170bhp 2.4 litre non turbo and 2.5 litre turbodiesel, this completes the V70 range. The article notes that the more powerful engine improves acceleration, but has little effect on torque, which leaves the 140bhp feeling just as flexible. The article also has reservations about the load-compensating suspension option - unless carrying loads regularly - as it tends to compromise the ride.

The petrol engine models have good noise control, but the review is less impressed by the diesel version which appears crude and somewhat lethargic. The article is very impressed by the estate's package, and recommends the lower rated petrol version. A small table summarises the models' performance. (RS)

Space mission

This is a 'What Car?' challenge: to replace a Mondeo for a smaller used car, retaining space and comfort. The article considers the Fiat Punto 1.2 ELX 5dr; the Hyundai Accent 1.5 GLXi 5dr; the Rover 214i SE 5dr, and the Volkswagen Polo 1.4 CL 3dr.

The Punto was found to be spacious and good looking, pricey - but with an excellent deal. The Accent was roomy and cheap, but noisy and not in pristine condition. The Rover was the quickest and offered air-conditioning rather than a sunroof, with a tempting deal. The Polo was in good condition, but it did not have 5 doors and the boot was too small.

Ultimately the Rover was chosen on the basis of the best mix of ability, age and price. The article includes a summary of each vehicle considered. (RS)

Still just a back seat hero

This is a review of the new Toyota Avensis range. The suspension has been adjusted for better ride and drive, there is a new range of petrol engines, and three body styles: hatchback (called liftback), saloon and estate. The Toyota retains its reputation for refinement, and well suppressed noise.
**Automobile Abstracts**  
October 2000 (31/10/2000)

The 1.8 (from the MR2 and Celica) has been retuned for greater mid range power, and the
2.0 litre is extremely flexible, with 0-60 at 9.1 seconds. Interior and exterior styling changes
have been kept to a minimum. Whilst the reviewer has some reservations about the
seating positions, the verdict is of a sensible and dependable, though unexciting, family
package. There is a table summarising the performance of the four derivatives. (RS)

**Sunny delight**

This article is a review of a comparative test between the BMW 3-series convertible, the
Volvo C70 convertible and the Mercedes-Benz CLK cabriolet. The article compares the
hood mechanisms, the driving experiences - in particular wind noise - and the in-car appeal
of the three vehicles. The performance, ride and handling of the vehicles is compared, as
well as stability and steering feel.

The Volvo is reviewed badly, with scuttle shake, an unresponsive engine and poor traction
attracting particular criticism. Despite being some £10,000 more than the BMW, the
Mercedes-Benz comes out as the superior car to the BMW, whose steering and chassis
don't match the quality of its engine. A figure tabulates comparative data for the three
models. (RS)

**Swooping S60 waves goodbye to the brick (Volvo S60)**

Car November 2000 01NOV2000, p 38 (2 p, 8 fig)
Index Terms: VOLVO
Doc No155397

**Takeover bid**

This is an extended and detailed report on a group test of four executive cars. The
contenders were the BMW 520i; Nissan Maxima QX 2.0 SE+; Peugeot 607 2.2 S, and the
Vauxhall Omega 2.2 16v CDX. The introduction points out that the 5-series has been What
Car?'s executive car of the year for five years, but that the Nissan and Peugeot models are
new, and the Vauxhall has a bigger engine. Each of the models receives a block of
photographs to enable comparisons of: styling; boot space; steering; cabin/driver
ergonomics, and seating arrangements (legroom/headroom). There is also an initial
impression given of each range, at which point the BMW and Peugeot take the lead,
followed by the Vauxhall and Nissan.

In terms of detailed discussion, the 'on the road' testing focuses on 'performance', 'ride and
handling' and 'refinement'. In this test, the Peugeot outperforms the BMW in refinement
and performance, equaling it on ride and handling. The article regards this achievement as
'a notable scalp for the French car'.

The 'in the cabin' comparison takes place under the categories 'behind the wheel', 'space
and practicality' and 'safety'. Whilst the BMW is the most comfortable behind the wheel, it
is beaten by the others for space and practicality, in which the Peugeot leads the field.

In the category of 'ownership', the article focuses on 'equipment', 'security', 'reliability' and
'buying and owning'. The Peugeot is the best equipped of the quartet, the BMW is
expensive to buy and run, but ultra-slow depreciation makes up for these costs.

The final verdict dismisses the Nissan and the Vauxhall. The Peugeot receives high praise
for its styling, package, equipment, performance and ride and handling, with only concerns
Automobile Abstracts October 2000 (31/10/2000)

over residual values counting against it. But the BMW wins on its blend of qualities. The article includes a full-page table comparing each model under test results, cost, equipment, running costs, performance and dimensions. (RS)

What Car? October 2000 01OCT2000, p 42 (12 p, 1 fig, 0 ref)
Index Terms: BMW/ PEUGEOT/ VAUXHALL/ NISSAN/ VEHICLE PERFORMANCE
Doc No154702

Three's little tweaks (Audi A3 1.9 TDI 130)

Car November 2000 01NOV2000, p 45 (1 p, 2 fig)
Index Terms: AUDI
Doc No155400

The ultimate, small driving machine?

This article reports on the first reveal of BMW's new Mini. The article comments on the size and package of the car, noting the deceptively large occupant space, but small boot size. This is caused by the rear axle, which is a derivation of the 3-series' bulky Z-axle, causing the fuel tank to be located under the rear seats.

The article comments on the interior style - reminiscent of Rover 75 and Audi TT. The style selection process is outlined. The article reports exceptional 'go-kart' handling, while safety is maintained through many primary and secondary safety features. (RS)

Car October 2000 01OCT2000, p 16 (4 p, 0 fig, 0 ref)
Index Terms: BMW/ MINI
Doc No155237

Upping the Swede stakes

This article compares tests of two family cars: the Honda Accord 1.8i VTEC S and the Volvo S40 1.8. The article compares the design philosophies of the two vehicles, the powertrain and performance. The ride and handling characteristics are compared, as are the interior styles, feature levels and equipment. Load space, and load space flexibility are appraised, and the article also compares purchase prices and ownership costs.

The article provides comparative figures showing cabin layout, rear seat, luggage space, and exterior pictures. The Honda is found to have a spacious cabin, sweet motor and gearbox and high general quality, but the article finds the ride firm, the economy poor and the image bland. The Volvo is praised for its looks, front seat comfort, safety and improved drive, whilst the ride, front grip and steering feel is felt to be poor. Overall, the article recommends the Accord as the better all-rounder. A table comparing the two specifications is provided. (RS)

What Car? October 2000 01OCT2000, p 152 (6 p, 3 fig, 0 ref)
Index Terms: HONDA/ VOLVO/ VEHICLE PERFORMANCE
Doc No154706

Vauxhall cross

This article reviews the Vauxhall VX220 and the related Lotus Elise. The reviewer particularly likes the 2.2 litre VX engine, which is torquey and smooth even beyond 6000rpm. The VX chassis is an extension of the Elise's, with a longer wheelbase and wider tracks. Suspension and steering feel solid and composed, but less 'animated' than the Elise. Also the hood's operation on the VX is more user friendly. But the reviewer has some reservations about the brand strength of the Vauxhall. (RS)

Car October 2000 01OCT2000, p 150 (2 p, 0 fig, 0 ref)
Index Terms: VAUXHALL/ LOTUS/ VEHICLE DEVELOPMENT/ VEHICLE DESIGN
Doc No155250
Warhorse fights back
The latest Toyota Avensis has a new engine range and some small styling updates. Three petrol engines with variable valve timing and one common rail diesel engine will be available. Some models will have a satellite navigation system fitted as standard. (HL)

Weight watcher
The Audi A2 is the first volume production car to use an all-aluminium chassis. Audi's Space Frame Technology retains the same torsional rigidity as conventional steel but weighs 43 percent less giving the A2 the lowest kerb weight in its class and good fuel economy and emission rates. The article looks at road handling, tax position and running costs. (HL)

What Car? used car of the year 2000
This article presents What Car?'s used car of the year under the following categories: supermini; small hatch; family car; executive car; luxury car; off-roader; MPV; estate car; sports car; hot hatch, and the overall winner.

The review presents a page per category, giving a winner for each category and five runners up. The winners of each category were as follows:
Supermini: Peugeot 206 1.1 LX 5dr.
Small hatch: Vauxhall Astra 1.6 LS 5 dr.
Family car: Volkswagen Passat 1.8 S.
Executive car: Vauxhall Omega 2.0 GLS.
Luxury car: Mercedes S320.
Off-roader: Nissan Terrano 2.7 TDi SR 5dr.
MPV: Vauxhall Zafira 1.6 Comfort.
Estate car: Volvo 850 2.5 10v SE.
Sports car: Subaru Impreza 2.0 Turbo.
Hot hatch: Peugeot 306 GTi-6.
Used car of the year: Volkswagen Passat 1.8 S. (RS)

Wholly smokeless 406 (Peugeot 406 2.2 HDi)

Wira's a weary Persona
A review of the Proton Wira (a renamed Persona) finds it with beneficial tweaks to the suspension and steering, with improved noise and vibration control. The powertrain offers extra power, and the equipment has been improved. However, the review finds it uncompetitive on price compared to newer rivals. (RS)
You VXy thing

This article reviews Vauxhall's new open top VX220. The car uses a version of the aluminium Lotus Elise chassis, giving the car a low, wide stance, and minimal weight. The composite body is streamlined and minimalistic in feel. The cabin features exposed alloy, and has no electric windows, power steering or air conditioning, which adds to the stripped-out sporting atmosphere.

The engine is the Astra coupe's aluminium 2.2 litre unit, which revs smoothly with good low-down torque. The reviewer is impressed by the acceleration (0-60mph in 5.6s), ride and sporty but poised handling. There is a small table summarising the performance. (RS)

Zero tolerance

This is a review of the new Honda Civic. In particular, the reviewer is impressed by the shape of the five door version, which seems to split the difference between a hatchback and MPV. The interior is described as having much more personality than previous Civics. Build quality is improved, with engines that are cleaner and more efficient. The engines are four cylinder aluminium 16 valve units meeting Euro IV emissions. The emphasis has been on driveability rather than all-out performance. MacPherson struts replace Honda's double wishbone front suspension. Electric power steering will be standard. Overall, the reviewer finds the car impressive, and potentially crucial to Honda's continued independence. (RS)

ELECTRIC VEHICLES

Necar: a saga to be continued!

The stages in the development of the Necar prototype are traced. The electric car based on the A Class was brought out in 1994 and has gone through four transformations so far. The latest version is run on batteries powered by liquid hydrogen fuel cells, all beneath the flooring. The car can reach speeds of 145km/h carrying five passengers and luggage, and has a range of about 450km. There will be even more refinements when the next stage is reached and then DaimlerChrysler will be ready to market a fully autonomous electric car. (CP)

ALTERNATIVELY POWERED VEHICLES

Escape plot

This article looks at the Ford Escape Hybrid Electric Vehicle project that will see the first mass-produced hybrid SUV on the market in 2003. The current program draws from experience gained over 20 years and technology used in the Prodigy program. It aims to develop a hybrid SUV that will qualify for Super Ultra Low Emission Vehicle status and retain good performance. An Atkinson cycle engine will power the HEV and the powertrain is likely to have two electric motors with a regenerative braking capability. (HL)
Fuel cell and methanol industry leaders to cooperate in a study on the introduction of methanol FCEVs

DaimlerChrysler AG, BP, BASF, Methanex Corporation, Statoil and Xcellsis have entered into a cooperation agreement to determine what would be needed to facilitate the introduction and commercialisation of methanol fuel cell vehicles (FCEVs). The article considers each member’s input to the methanol FCEV project, which will allow well-informed decisions to be made about the potential use of methanol as a transport fuel. (RS)

A new generation of buses

The Nebus, a new electric bus powered by liquid hydrogen fuel cells in the roof, was developed by DaimlerChrysler and tested in Hamburg last Christmas. It has a range of around 250km, so can easily run the 140 to 170km distances covered by buses on average each day. The Nebus uses a low-level powered axle developed by ZF, and electric motors integrated in the wheel hubs to provide the equivalent of 200hp. There is no pollution as the Nebus only emits water vapour. The only drawback of the vehicle is its price. (CP)

ProActive

The Citroen Xsara Dynactive hybrid prototype has a conventional 1.4-liter petrol Xsara with a flywheel motor-alternator. The flywheel unit will be used in motor mode for starting the engine enabling the traditional starter and lead acid battery to be dispensed with. The prototype is described. (HL)

Tomorrow's world

This article road tests the Honda Insight and Toyota Pirus petrol-electric hybrid cars. The Pirus is powered by Toyota's Hybrid System where power from the petrol engine is linked, through the hybrid system, to a high-torque electric motor and generator. The Honda Insight uses Integrated Motor Assist that comprises a light weight petrol engine with VTEC technology and a new lean-burn catalyst. The electric component consists of batteries and an advanced Power Control Unit. Styling, performance, cabin and interior, tax position, equipment and value and running costs are looked at for both cars. (HL)

Web hybrid comes clean

Nissan has released a hybrid version of its Tino model, equipped with the NEO HYBRID system that combines a gasoline engine and an electric traction motor. The Tino uses the HYPER CVT, a compact lithium-ion battery especially designed for hybrid applications. The car will initially be sold over the internet. (HL)
NOISE AND VIBRATION HARSNESS (NVH)

Measurement of sound and vibration quality of commercial vehicles

Last year, the AVL method for the analysis of vehicle interior sound quality was extended to cover application to commercial vehicles. With this system, sound qualities such as the perceived 'annoyance' or impressions such as 'reliable' and 'powerful' can be analysed objectively. The advantages of this development tool for manufacturers of commercial vehicles lie in the fact that development effort is considerably reduced, quality target parameters are defined and quality 'benchmarking tests' can be carried out. (Auth)

Presentation of tire road noise chassis dynamometer system with ISO surface replica model pad

As a new test facility to clarify the methods of noise measurement and reduction for tire road noise during vehicle accelerating operation, Tire Road Noise Chassis-Dynamometer System has been developed. ISO surface replica pads made by copying the texture of ISO surface were attached on the roller surface of this System to simulate tire road noise. This paper describes the specifications and characteristics of this System, and the effects of ISO surface replica pads on tire noise measurement. (Auth)

Recent sound visualization technique for automobiles

In recent years sound visualization techniques were developed to know the sources and paths of the exterior noise radiated from both stationary and moving vehicles. Firstly theoretical background of Nearfield Accoustical Holography. Accoustical Double Holography and microphone array technique is reviewed. And then the application of these techniques to the sound source identification of the vehicle on pass-by test, of the engine on the bench and on vehicle, of the rolling tire and of the brake squeal was described. (Auth)

AERODYNAMICS

Full-scale low noise aerodynamic wind tunnel

As much attention has been drawn to environmental issues, to meet the needs for fuel efficient and quiet cars becomes more important and urgent. In this report, the titled wind tunnel, one of our staple facilities, is presented with some examples, such as high speed flow visualization with laser light sheet and a high speed camera and a measurement of aerodynamic noise around the car body with a new type super directional microphone array system. (Auth)
Large scale low noise wind tunnel

The RTRIs Large-Scale Low-Noise Wind Tunnel is a unique railway wind tunnel built for the purpose of studying aeroacoustic and aerodynamic phenomena for high-speed trains. This tunnel has two excellent features. One is an extremely low background noise level which makes it possible to measure the aerodynamic noise generated from a model with remarkable accuracy. This must be useful for studies for reducing the aerodynamic noise from high-speed trains and automobiles. The other is a large and high-speed moving belt ground plane, which enables to simulate a flow between the model and the ground with considerable reality. (Auth)

BRAKING PERFORMANCE

Introduction of 6 brake dynamometer for heavy duty vehicles

The frictional coefficient of frictional materials fitted on the brake units depends on the heat history, frictional speed, their surface temperature and so on. Since the evaluation tests of service brake performance take usually long time, the single or dual brake dynamometers are widely used. Then the authors introduced a 6-brake dynamometer to evaluate precisely the brake performance of a heavy-duty vehicle with 6 wheels. The necessity of the 6-brake dynamometer for heavy-duty vehicle is discussed here, based on the comparative experiment among single and dual brake dynamometers and actual vehicle running test results. The requirements for the 6-brake dynamometer are shown here. The 6-brake dynamometer proved to be useful for the development of service brake system for heavy-duty vehicles with 6 wheels. (Auth)

ERGONOMICS

Regulations and routines for approval of passenger cars adapted to drivers with disabilities - including an international survey

The report describes the current regulations and routines for driving licensing and rules applied for matters concerning driving licensing and vehicle adaptation for people with physical impairments in Sweden. Deficiencies in the so called mediating process ie., from initial assessment of fitness to drive to adaptation of the car and driving licensing are identified and described. The Swedish conditions are compared to other countries and preliminary recommendations are presented concerning test/assessment of fitness to drive, driving test and vehicle inspection, adaptation evaluation, standards and directives, and competence centres. (Auth)

Driver distractions covered at Convergence

This article summarises papers on driver distraction due to be given at the Convergence 2000 conference. Using speech-based e-mail was found to increase reaction time by 30%. Statistics of deaths related to the use of cell-phones is summarised. The papers points to the need for more research into the safe use of telematics and communication devices in cars. (RS)
Recognising drug use and drug related impairment in drivers at the roadside

It is apparent from the large number of negative breath tests and the small number of drug driving submissions, that in the case of a negative result from a breath test for alcohol police officers are not considering whether that person may be impaired through drugs. This may be in part due to a lack of skills in identifying the signs of drug use in a driver. Drug Influence Recognition Training (DIRT) for police officers has recently been initiated. Police officers from six forces received training in drug influence recognition and also in the administration of a standardised Field Impairment Test (FIT). These officers then applied their training in a real world setting for a period of two months. As a comparison, specially trained TRL interviews have also used these techniques at two city locations. People exiting clubs and public houses were invited to provide a saliva sample and perform the tests involved in DIRT/FIT. All samples (from both the police and TRL trials) have been analysed by independent forensic laboratories. Results show that the DIRT/FIT techniques are very useful in identifying impairment and the likely drug group responsible. This paper reports the results of both sets of trials and provides a list of recommendations based on experiences of the police and the TRL team. (Auth)

SAFETY - GENERAL VEHICLE SAFETY

The effect of color contrast on daytime and nighttime conspicuity of roadworker vests

A static field study was conducted, both during the day and at night, to examine the effect that color contrast within a safety vest has on noticeability. Fluorescent orange and yellow fabrics were matched with orange, yellow, silver, or white retroreflective trim to appear similar to a safety vest. The method of paired comparisons was used to develop a linear scale of how noticeable the various color combinations appeared under cluttered and uncluttered viewing conditions. The results indicate that color contrast within the safety vest, as well as relative to the environmental surround, affects judgments of noticeability. However, in the nighttime condition color contrast was not an identifiable attribute, as all the retroreflective materials used appeared white when illuminated. In the nighttime condition, the luminance of the retroreflective trim accounted for almost all of the variance in the noticeability judgments. The results of this study suggest that a design for safety apparel that includes a combination of fluorescent yellow and fluorescent orange fabrics (providing color contrast for the daytime) with silver/white micro-prismatic retroreflective trim (proving high luminance for nighttime) is likely to be the most noticeable combination in both daytime and nighttime conditions. (Auth)

Road safety issues in remote Aboriginal communities in Western Australia

A series of interviews with the chairpersons of Aboriginal communities in a remote area of Western Australia were conducted to examine their attitudes to road safety problems. It was found that some road safety issues that were expected to be considered problems were not necessarily seen to be so by those interviewed. This finding suggests that the first stage of a road safety intervention program for Aboriginal people may need to include an awareness raising component. It also suggests that there is a need for more detailed
research defining particular problems more accurately before effective and culturally appropriate countermeasures are developed. (Auth)

Accident Analysis & Prevention Vol 32 No 6 01NOV2000, p 845 (4 p, 1 fig, 15 ref)
Index Terms: SAFETY/ AUSTRALIA/ ACCIDENTS
Doc No154626
BODY DESIGN

Tailor made alloys
Due to its significant contribution to light weighting of new car models, the usage of aluminium in the automobile industry is increasing rapidly. Aluminium has proved to be successful for the chassis and for the powertrain in the past but new alloy developments for skin panel applications will accelerate the replacement of the commodity material steel. (Auth)

SAFETY COMPONENTS - AIRBAGS, RESTRAINTS, ETC

Application of the statistical design support system toward optimisation of vehicle safety equipment
The "Statistical Design Support System" produces a new practical optimal design method. It can be used even on non-linear behaviour. The optimisation can be done with this system using a small number of calculation results. Therefore, the effect is especially significant when applied to a problem that needs large-scale calculation. The authors applied it to the optimisation of design parameters of the occupant restraint system, and have tried to reduce the injury criteria of occupants based on the crash simulation. According to the improvement of interest and technology on vehicle safety, many countries have declared new safety assessments that are more severe than used one. In order to meet them all, it will be needed to consider some different crash situations simultaneously when vehicle safety equipment is designed. The authors made optimal design with consideration of different conditions of collision. This paper draws attention to the effectivity analysis and optimisation. (Auth)

Breaking the crash barrier
Jaguar have developed a new Adaptive Restraints Technology System that will be fitted to the new Jaguar XK. The system uses ultrasound and artificial neural network technology to continually analyse and update the position and presence of occupants in the car’s front-seats. During a crash the system assess the severity of the collision and deploys appropriate safety measures, from just activating seat belt pre-tensioners to second stage airbag inflation. (HL)

Jaguar sets the pace in ultrasonic cockpit sensing
Jaguar has developed an occupant sensing system using ultrasonic technology. A number of ultrasonic sensors within the car monitor the volume and position of front seat passengers. The information is interpreted by an artificial neural network which decides whether to allow or disable airbag deployment. (HL)
Low-cost video camera sensor for ACC

Adaptive cruise control (ACC) systems sense obstacles ahead of the vehicle and vary the speed to maintain a safe following distance. MobilEye Vision Technologies Ltd. have developed an algorithm for a single video camera for ACC, lane-departure warning, and in the future, collision avoidance. The article goes on to describe MobilEye’s system and outlines the algorithm used. MobilEye test systems are currently running on 32-bit microcontrollers from Motorola.

The article goes on to describe the limitations of current radar and laser ACC systems, and discusses the advantages of MobilEye’s algorithm - which considers the change in object's size over time, road curvature and parallax. (RS)

Modelling the factors related to the seatbelt use by the young drivers of Athens

Road traffic accidents in Greece are one of the major problems of the public health sector and the first cause of death in the ages 18-24. However, there are no records available for defining the determinants of road accidents and seatbelt wearing rates. The main objective of this study is to determine and clarify the relationship between young drivers’ intentions (motivation to use/non use seatbelt) and their behaviour (self-reported use). Additionally, the purpose of this study is to evaluate the seatbelt wearing rates among young drivers in relation to their trip-type. The sample consisted of 200 young Greek drivers of both sexes.

The statistical analysis included factor analysis and multiple regression analysis. The seatbelt use was measured in relation with seven trip-types. Through factor analysis, a seven factor scale of seatbelt use and a four factor scale of seatbelt non use were created which included Greek young drivers' basic motivations for wearing or not wearing a seatbelt. A model, constructed by the multiple regression analysis, revealed the factors related with the seatbelt use. The factors positively related were 'imitation', 'self-protection', and 'legality'. The factor of 'discomfort' is negatively associated with the seatbelt use. Furthermore, mileage was negatively related with seatbelt use. Finally, some preliminary suggestions on how prevention strategies should be implemented in Greece are discussed. (Auth)


As part of Michigan’s effort to track trends in safety belt use within the state over time, the University of Michigan Transportation Research Institute conducted 20 statewide surveys of safety belt use between 1984 and 1998. Results indicate that Michigan safety belt use trends for drivers and front-right passengers are similar to other statewide and national trends. Belt use in Michigan increased dramatically immediately after the state implemented its mandatory belt use law (secondary enforcement) followed by a smaller decline that levelled off at a rate more than 20 percentage points higher than before the law. Belt use was consistently higher among drivers than front-right passengers, older than younger front-outboard occupants, females than males, and front-outboard occupants exiting freeways than those stopped at local intersections. Examination of belt use trends in Michigan provides useful information for continued efforts to increase belt use in our state and for all states interested in meeting national goals for safety belt use for the year 2000 and beyond. (Auth)
HEATING, VENTILATING AND COOLING (HVAC)

Denso puts hot and cold in a single unit

Denso has developed a combined radiator and air-conditioning condenser for cars. The SF Cooling Module, developed with Toyota, is to be installed on the Pirus hybrid car that goes on sale in Europe this autumn. The radiator and condenser share cooling fins which have a slit to optimise the performance of both. (HL)

Non-idling air conditioning in commercial vehicles

The engine-independent or "non-idling" air conditioning system developed by Behr GmbH & Co. is completely integrated in the normal vehicle air conditioning system. This means that the existing elements for control, flow, distribution, temperature regulation and purification of the air can also be used for engine-independent operation. In this case the cabin is cooled by the cooling battery for up to eight hours! In summer this means that a pleasant climate can be maintained in the cabin during waiting times, traffic jams, breaks and other trip interruptions as well as at night when the driver needs a good sleep. As well as increasing the comfort and thus the performance of the driver, the combined normal engine-dependent and engine-independent air conditioning also increases safety and efficiency of truck operation. (Auth)

INTERIOR FITTINGS

Interior Appointments

One of the development aims during the development of the new C-class was to combine the youthful and exciting design of the interior with high-quality materials. The objective in doing so was to achieve soft surfaces and tangible, agreeable haptics. Great importance was attached to the correct ergonomic arrangement of functional components as an inherent feature of even the basic equipment. Occupant comfort was the primary objective during our development work: outstanding seating and climatic comfort, as well as excellent acoustic insulation guarantee safe, relaxed driving and a high level of stress-relieving safety. (Auth)

STRUCTURAL MECHANICS

Analysis of 2-D steady-state thermoelasticity by a simple adaptive boundary element method

This study is concerned with a new adaptive boundary element method based on sample-point error analysis for thermoelasticity under steady-state heat conduction. Mathematical formulations of the adaptive boundary element method are presented in detail for two-dimensional thermoelasticity. This scheme of adaptive meshing makes use of only the residual between the interpolated and calculated solutions as an error indicator. Adaptive boundary element analysis can be performed by simultaneously checking the 'displacement error indicator' and the 'temperature error indicator'. The \( h \)- and \( p \)-version mesh refinements based on this scheme are applied to some typical examples, and the
usefulness of the proposed adaptive BEM is demonstrated through discussion of the results obtained. (Auth)

Representation of topology using homology groups and its application to structural optimisation

Genetic algorithm (GA) is one of the most useful methods to optimise topology of structures. The performance of GA, however, deeply depends upon a rule of coding from a structure to a string (a chromosome), which must be decided before the execution of GA. An improper coding can cause a lot of unanalysable structures to be generated in the process of optimisation, which are separated into several pieces with no supporting or loading points. In this paper, a method to give such unanalysable structures a fitness value based upon their topology using homology theory is proposed to raise the probability of obtaining the optimum structures. As numerical examples, topology of two-dimensional frames and three dimensional structures consisting of triangular elements supported on a rigid wall and loaded vertically on a point distant from the wall are optimised under a constraint of constant weight. As a result, it was found that the proposed method increased the, average fitness value and the number of optimum structures obtained in 100 trials of GA in comparison with other methods that considered unanalysable structures to be useless. (Auth)

Sensitivity analysis for thermal stress and creep problems

In this work, a finite element sensitivity analysis method for thermal stress and creep problems is proposed. The method is characterised by the semi-analytical direct differentiation approach, i.e., the formulation is based on the direct differentiation but the variation of internal force due to the perturbation of design parameters is evaluated numerically. Since the corresponding subroutine of an existing finite element analysis code may be used, it is unnecessary to manipulate the adopted constitutive relation at the sensitivity analysis stage. Thus, the proposed method can be applied for various temperature- and time-dependent problems. The effectiveness of the method is examined through two numerical examples. (Auth)

Statistical properties of fatigue life simulated for notched components under combined loading

Failure lives of notched components in multiaxial fatigue were statistically estimated by Monte Carlo simulations for materials with different microstructures using a proposed crack growth model. An analytical algorithm for crack growth in a microstructure, which was modelled as an aggregate of hexagons, was based on competition between two possible growth modes. In simulations, various microstructure configurations, which resulted in distinct failure lives, were randomly generated for a material under consideration. Ranges of simulated life almost coincided with experimental results observed in four kinds of materials. The coefficient of variation and the shape parameter in the fitted two-parameter Weibull distribution function for the simulated life distribution were investigated to clarify statistical properties of the failure life in multiaxial fatigue. The life dispersion was found to be larger under a loading mode with a higher proportion of shear stress component and/or in a material with coarser grains. (Auth)
SUSPENSION SYSTEMS

Air suspension for the Audi allroad quattro
The Audi allroad quattro's variable height air suspension is one of the decisive technical features that give this model its all terrain capability without restricting its suitability for use on normal roads. This article describes the air suspension and how it works. (Auth)

Increasing road comfort by optimising the coupling of power unit and suspension mounts
Direct measurement of the dynamic forces between suspension and body as well as between power unit and body, and the analysis of the combined effect of these forces on body movement in the time domain, when an obstacle on the road is driven over reveal additional opportunities to optimise ride comfort. When designing the power unit and suspension mounts for new Audi models, the power unit mass can be used specifically as a vibration absorber to work against excitation forces on uneven surfaces and thus to further improve ride comfort with a "compact" dynamic feeling. The development work described in this document was carried out on an Audi A6 by AFT Atlas Fahrzeugtechnik, on behalf of and in co-operation with Audi. (Auth)

Insight: Shock of the new
This article describes the development of racing damper technology. The article gives the history of Koni's involvement in Formula 1, tracing the development from the double-tube shocks used up until 1982, through the monotube damper - model 3012 - introduced in 1983, to its subsequent single- or double-adjustable versions. The article also traces the involvement of Jeff Ryan of Penske Racing Shocks in the development of the three-way and four-way adjustable damper.

The article describes the active suspension systems developed by Lotus and Williams in the 1980s. After active suspensions were banned in 1994, special systems such as in-line and internal reservoir designs were developed. The article continues by discussing the more recent developments in damper technology from Koni and Penske. The article includes diagrams of Penske's in-line reservoir damper and its 8750 damper, together with numerous photographs of damper installations. (RS)

The MTD - A new damping system for automotive powertrains
The company GAT-Gesellschaft fur Antriebstechnik mbH has launched the production of a new damping system which combines low production costs with high efficiency. Like other dual mass flywheels, this torsional damper, known as MTD (Mechanical Torsion Damper), is based on the distribution of the momentum of inertia of the engine flywheel over two single masses with a spring damper system placed between them, but has a simpler design and a small number of basic parts. (Auth)
Steel reveals its lightweight potential
Lotus Engineering have developed five new lightweight suspension systems as part of the steel industry's UltraLight Steel Auto Suspension (ULSAS) programme. Lotus concentrated on the four most popular rear suspension systems, twist beam, double wishbone, struts with links and multi-link systems as it was felt that these could offer the greatest weight and cost savings. Lotus were also asked to design a new rear suspension system. There are no plans at present to build prototypes of these suspension systems. (HL)

The suspension - advances in driving dynamics, safety and comfort
The new C-class represents a milestone for Mercedes-Benz in terms of driving dynamics, safety and comfort. The task confronting the suspension development engineers was to advance the classic Mercedes strengths of handling safety and comfort even further while setting new standards in the dynamic aspects of agility, steering precision and driving enjoyment. This was only possible by comprehensive optimization of the suspension concept using a new three-link front suspension, a refined multi-link independent rear suspension and a new rack-and-pinion steering system. In conjunction with the onboard control systems this suspension ensures safe handling very near the physical limits. (Auth)

Vehicle dynamics simulator
We have developed a vehicle test system called Vehicle Dynamics Simulator (VDS). With this system we can measure the handling characteristics in a transient state in the laboratory. The automobile suspensions are moved as on a road with the machine providing relative motion by the force transducer platform beneath each tire. The suspension kinematics and compliance characteristics contributed to the good handling performance and stability have been shown by the detailed measurements of transitive motions and forces given to the wheel. This paper presents the system introduction and the results of analysing the suspensions characteristics. (Auth)

STEERING SYSTEMS
BMW demonstrates active steering
BMW have developed an Active Front Steering (AFS) system that evens out yawing and reduces braking distances. The company have been working towards steer-by-wire and the AFS system is an interim solution until steer-by-wire is legalised. AFS is based on a conventional power steering system but has an additional electric motor fitted to the steering column. Through a planetary gear support, the system provides more or less steering effort as required. (HL)
Driver intuition

This article considers a partnership between lift-truck manufacturer Linde and American supplier Lord, which designed a steer by wire system for Linde's R14-R20 Active electronic vehicles. The result was the MR damper - a variable torque device providing resistive force feedback in the steering system. The resulting steering characteristics can be tuned to provide the correct intuitive feel to the driver. The article goes on to describe the advantages of the variable torque feedback system. (RS)

OEM Worldwide  September 2000  01SEP2000,  p 38 (1 p, 0 fig, 0 ref)
Index Terms: DAMPERS/ STEERING SYSTEMS/ LINDE/ LORD
Doc No155368

Wheel loaders take the lead

This article considers the reduction of steering effort and the reduction of shoulder, elbow and arm fatigue through the application of advanced load-sensing steering systems. The article also describes Caterpillar's steering system, which allows 140 degrees or wheel rotation lock to lock. An ergonomic grip allows for a neutral wrist position throughout the rotation. The Volvo steering system is also described. The article concludes with a review of stick-steering systems. (RS)

OEM Worldwide  September 2000  01SEP2000,  p 14 (3 p, 0 fig, 0 ref)
Index Terms: STEERING/ CATERPILLAR/ VOLVO
Doc No155367

Wires and wherefores

BMW's Z22 research vehicle is fitted with steer-by-wire technology. This means that the steering of the front wheels is done electronically rather than manually. Present legislation requires the steering wheel to be connected to the road wheels mechanically and steer-by-wire systems do not do this. So BMW have also developed AFS (Active Front Steering) which provides most of the benefits of full steer-by-wire while retaining a mechanical link. (HL)

Autocar 06SEP2000,  p65 (1 p, 2 fig)
Index Terms: BMW/ STEERING/ STEERING SYSTEMS
Doc No155255

BRAKING EQUIPMENT

BMW X5 electronic brake management

As well as the famous slippage and stability systems, the X5's electronic brake management includes new specific four wheel drive functions like hill descent control HDC or the automatic differential brake ADBX. As an integral component of the vehicle concept, X5's electronic control system makes a fundamental contribution to its brake, stability and traction performance both in on and off road driving. The following article deals with these systems in detail. (Auth)

ATZ 9/2000  01SEP2000,  p 36 (5 p, 2 fig, 3 ref)
Index Terms: ELECTRONIC BRAKE MANAGEMENT/ FOUR WHEEL DRIVE/ HILL DESCENT CONTROL/ AUTOMATIC DIFFERENTIAL BRAKE/ ELECTRONIC CONTROL/ BMW
Doc No155443
(In GERMAN and ENGLISH)

ANTI-LOCK SYSTEMS

Anti-lock braking systems on four wheel drive vehicles : Part 1

In order to combine four wheel drives with vehicle dynamic control systems, Continental Teves had to develop methods of mastering the specific basic problems which four wheel drives cause. In the following article, the company describes problems and solutions and shows which controls are necessary for the different four wheel drive concepts. Part 2 of this article will follow in the next edition of ATZ. (Auth)
TYRES

Designer tires

The Falken Tire Corporation have developed a new tire, called the Ziex S/TZ01 it was designed for light trucks and SUVs. The company aimed to produce a bigger wheel package while maintaining a standard or near standard overall diameter. Styling was also important as was testing the tire’s performance on a number of vehicles. (HL)

Effect of fatigue step loading sequence on residual strength

Miner’s rule is often assumed to hold in accelerated fatigue tests. This rule implies that the order in which loads are applied is not significant. Whether particular loads are applied early in the test or later is unimportant; they are expected to cause the same amount of damage if they are imposed for the same number of cycles. In order to test this hypothesis, we have investigated the effect of loading sequence on residual strength using two levels of tensile strain and several representative rubber compounds. In all cases, a series of increasing strains was found to reduce the strength to a greater degree than the same strains applied in decreasing order. Thus, Miner’s rule does not hold for the fatigue failure of these compounds. However, the relative rankings of the compounds remained the same in both step-up and step-down strain sequences. (Auth)

Hydroplaning analysis by FEM and FVM: effect of tire rolling and tire pattern on hydroplaning

We established the new numerical procedure for hydroplaning. We considered the following three important factors; fluid/structure interaction, tire rolling, and practical tread pattern. The tire was analysed by the finite element method with Lagrangian formulation, and the fluid was analysed by the finite volume method with Eulerian formulation. Since the tire and the fluid can be modelled separately and their coupling is computed automatically, the fluid/structure interaction of the complex geometry, such as the tire with the tread pattern, can be analysed.

Since we focused the aim of the simulation on dynamic hydroplaning with thick water films, we ignored the effect of fluid viscosity. We verified the predictability of the hydroplaning simulation in the different parameters such as the water flow, the velocity dependence of hydroplaning, and the effect of the tread pattern on hydroplaning. These parameters could be predicted qualitatively.

We also developed the procedure of the global-local analysis to apply the hydroplaning simulation to a practical tire tread pattern design, and we found that the sloped block tip is effective in improving hydroplaning performance. (Auth)
Automobile Abstracts  October 2000 (31/10/2000)

Lasting performance of rayon

In the US nearly all radial car tires are reinforced with a PET (polyester) carcass, previously rayon was the material of choice. This article looks at the work of Acordis Industrial Fibres into the in-tire behaviour of these different fibres. Thermal shrinkage, modulus and dimensional stability were investigated, carcass loading and temperature in the tire simulated and sidewall indentation looked at. The research undertaken is described and the performance of the two materials is compared. (HL)

Tire Technology International 01SEP2000, p46 (3 p, 3 fig)
Index Terms: TIRES/ TYRES/ FIBRES
Doc No154592

The local effects of friction between the tyre and the road

The following article examines the local effects of friction between passenger car tyres and the road, the deformation of the tread elements and the local slip between the tyre rubber and the road surface. These two movements determine to a great extent the frictional process which allows force to be transmitted from the tyre to the road surface in both a longitudinal and a transverse direction. The report summarises the results of a dissertation based on research carried out at the Department of Automotive Engineering at Darmstadt University of Technology. (Auth)

ATZ 7-8/2000 01JUL2000, p 45 (4 p, 11 ref)
Index Terms: FRICTION/ TYRE/ ROAD/ TREAD ELEMENTS/ DEFORMATION
Doc No155263
(In GERMAN and ENGLISH)

Netherlands JV to accelerate run-flat systems

Goodyear and Michelin are to cooperate through a research and development joint venture company to provide vehicle makers with a range of run-flat tyre systems. The venture will help address the concerns of drivers to better manage loss of air pressure. Both companies will licence current technology to the other including, extended mobility tyre technology developed by Goodyear and the PAX system developed by Michelin. (HL)

European Automotive Design Vol. 4, No. 7 01SEP2000, p5 (1 p)
Index Terms: GOODYEAR/ MICHELIN/ TIRES/ TIRES/ RUN FLAT TIRES
Doc No155460

A new tire model to predict vibration emission of counterbalance trucks

Counterbalance trucks are machines in widespread use in every industrial sector. Unlike cars, they are not designed with suspension systems. Consequently, they are considered to be high vibrating vehicles. Nevertheless, like suspension seats, tires can be selected as suspension parts. This paper presents a new numerical model for the analysis of the vibratory behavior of counterbalance truck tires. This model was intended to be a part of a fork lift truck model, including axles, chassis, and cabin. All the results reported here show a close agreement between measurements and numerical simulations. Thus, it can predict the vibration emission values at the driving position and is used to compare the efficiency of solid tires with pneumatic tires in terms of transmitted vibration levels. (Auth)

Tire Science And Technology Vol 28, No 2 01APR2000, p 119 (19 p, 20 fig, 13 ref)
Index Terms: COUNTERBALANCE/ TYRES/ TIRES/ SIMULATIONS/ VIBRATION/ TRUCKS/ MODEL/ AXLES/ CHASSIS/ EMISSIONS
Doc No155461

Relationship between the friction and viscoelastic properties of rubber³

In this study, the relationship between friction and viscoelastic properties such as loss tangent tan S and storage modulus $E'$ were examined. Wet skid resistance was measured using the British Pendulum Tester. The rubber specimens were rubbed against five silicone carbide cloths of differing abrasive grain sizes. The viscoelastic properties of the rubber specimens were measured with a viscoelastic spectrometer. From the data on wet skid resistance and viscoelastic properties, it is found that the coefficient of friction $\mu$ varies as follows:
\[ \mu = a + b \tan S/E' \]
where \( a \) and \( b \) are constants. \( \tan S/E' \) was related to the hysteresis term of friction, and the \( \mu \)-frequency curves were compared with the \( \tan S/E' \)-frequency curves. (Auth)

A three dimensional dynamic tire model for vehicle dynamic simulations

Traditional multibody dynamic (MBD) tire models concentrate on the tire patch force development and the tire in-plane characteristics. The tire laterals dynamics and nonlinear effects caused by the tire compliances during rough terrain driving and severe maneuvers are mostly neglected in vehicle analytical simulations. The tire finite element models, though capable of dealing with these phenomena, are basically not designed for quick vehicle dynamic evaluations. A simple three-dimensional (3-D) MBD tire model for full vehicle performance and maneuvering simulations over various road surfaces is therefore desirable for the ever expanding analysis capabilities and the improved accuracy of the computer-aided vehicle design analysis. In this paper a tire modeling concept to extend the in-plane dynamic tire model to full 3-D tire dynamics is proposed. Essentially, this tire model divides the traditional tire/wheel system model into three elements: two rigid bodies representing the wheel mass/inertia and the tire tread mass/inertia, and a spring/damper representing the sidewall visco-elasticity. Thus, 6 degrees-of-freedom (DOFS) are added for each tire over traditional tire models, using any existing tire patch force calculation model, this proposed model can be used to simulate full 3-D dynamic responses of a vehicle. To implement this model, techniques to extract the nonlinear spring rates of the sidewalls and to enhance the tire patch force calculations over uneven terrains are explained in this paper. Results of the vehicle simulation using this tire model were compared with measured field data. They showed that this tire modeling concept yields a practical representation for tire 3-D nonlinear dynamic characteristics. (Auth)

Treading a fine line

Firestone's ATX, ATX II and Wilderness AT tyres have been recalled due to fears that they have been responsible for a significant number of deaths. The majority of affected US tyres were produced at a plant in Illinois during a period of labour strife. Several workers complained about questionable manufacturing procedures, including the use of solvents to permit the use of aged rubber. Some tyres were also shipped out with a specified nylon ply missing that was intended to prevent tyre failure during hard driving and high temperatures. (HL)

Treading safely

The article points out that tyres are 12% of the cost of running a truck. The article outlines methods of optimising tyre efficiency. Firstly the impact of tyre pressure and wheel alignment is discussed. Furthermore, there are now ranges of different tyres dependent not just on truck/drive configuration but also on duty cycle. The article finally warns of the legal implications of using worn tyres. (RS)
Two dimensional collisions of vehicles (Case of consideration tire during impact)

This paper deals with the two-dimensional Collisions of vehicles. The authors have already analysed the vehicle collisions in consideration of vehicle movements during impact. In those studies tire forces acting in the duration of impact were not considered. However, it does not seem that they can be ignored under any impact condition. In the present paper, therefore, the authors introduce the impact forces acting between two vehicle bodies and tire forces acting from the road into the equations of motion of four-wheel vehicles and analyse the vehicle motion throughout the vehicle collisions (pre-impact, impact and post-impact vehicle motion). Finally, they compared the results obtained from the present method with those obtained from the method ignoring tire forces acting in the duration of impact. It is shown from the comparisons that tire forces acting in the duration of impact affect the vehicle velocities after impact and the vehicle trajectories are not predicted correctly if they are neglected. (Auth)

Tyre/suspension aligning moment and vehicle pull²

Vehicle drifts are affected by the forces and moments of the tire and the suspension. A steering moment equation that calculates the residual aligning torque (RAT) of a tire matched to a vehicle is derived. Using this equation, tire makers can save on development cycle time by delivering matching tires as soon as the suspension configuration is defined. (Auth)

Which cord?

This article looks at the work of Dunlop in developing a lighter tire. Dunlop initially sought an alternative to the steel used in a conventional tire, and found that polyaramide fibre provided similar material properties to steel but at much lower weights. The work culminated in the 195/65 R 15 Dunlop SP Sport 200 ULW (Ultra Light Weight) tire developed in conjunction with Audi for use on the A3. The development work is described and comparisons between the ULW tire and conventional steel tires given. (HL)

Engine Design, Performance and Economy

And now for another Oz invention - the six-stroke engine

This article describes the six-stroke engine concept that incorporates a new cylinder-head design that combines the advantages of both two and four stroke engines. The engine concept has only been adapted to air-cooled motorcycles at present, although the design could be applied to virtually any conventional four-stroke configuration. (HL)

Double six

This article discusses the problems of competitiveness in GT racing which led to TVR's development of a V12 engine. The article traces the reasons leading to the setting of the design parameters for the engine, notably those of cost control. The block and crankcase design is discussed, and then the engine's fabrication process (making use of a large rotatable jig) is set out in detail. The specific design problems associated with the cylinder
Early evaluation of the influence of complex components on the charge cycle using ID-3D coupled flow simulation

In modern engine development, the concept phase is characterised by employing a number of different CAE tools. The aim of this hardware free stage is to select suitable design versions as well as to ensure a pre-optimised design of the components. In this context, established simulation tools such as 1D and 3D flow simulations are making significant contributions to the area of engine development. Coupling both methods dynamically is a relatively new approach that has not yet been employed very frequently. Using a complex intake manifold geometry as an example, the following article by BMW demonstrates that realistic statements regarding engine function can be provided by applying 1D-3D coupling. (Auth)

Integration of simulation tools to optimise engine concepts

The following paper by AVL List GmbH deals with the integration of various simulation tools for defining an engine concept or optimising the thermodynamics layout. The three substantial steps, parameter specification, calculation of variants and the automated optimisation, are described. To represent the internal engine processes completely, new or improved simulation models are introduced for combustion, NOX formation and heat transfer. Verification examples illustrate the capability of the applied calculation models. Based on the creation of an engine concept, the operation of the layout method is clarified. (Auth)

Modern calibration gas supply systems for low emission applications

The new EURO III/IV and ULEV/S-ULEV exhaust gas regulations also affect the concept of operating and calibration gas supply systems to a great extent. In order to transfer low calibration or span gas concentrations in the lower ppm level from the gas cylinder to the analyser without changes in concentration, the gas supply system must fulfil certain minimum requirements. Hale Hamilton has reacted to the future demands on exhaust measuring techniques by developing a new test gas supply concept for exhaust measurement as a turnkey solution. (Auth)
The new Mercedes-Benz 12 cylinder engine with cylinder cut off

A completely new 12-cylinder engine has been developed for the new S-Class and the CL Coupé version. The engine has been designed such that the classic conflict between performance and comfort on one side, and fuel consumption and emissions on the other, has been solved in an optimal manner. The first part of the report describes the basic concept and mechanical structure. In the second part [1] the thermodynamic characteristics, emission control concept and engine management are explained. (Auth)

The new Mercedes-Benz 12 cylinder engine with cylinder shut off

The development objectives underlying the new Mercedes-Benz 12 cylinder engine were highly ambitious, not only in terms of performance and drive comfort but also with regard to fuel consumption and exhaust emissions. This fact is reflected primarily in this second section of this technical paper, containing a description of the major combustion-related components such as cylinder shut-off, the exhaust system and the AC ignition system with ion-flow diagnosis. This last feature is a world production first. (Auth)

The new Mercedes-Benz V-8 passenger car diesel engine

Following the introduction of the passenger car diesel engine for the Smart, which at 0.8 litres cylinder capacity is the smallest, the passenger car diesel sector in top class motoring is now rounded off with the introduction of the new 8 cylinder diesel engine. Here as in the case of the 3 cylinder diesel engine, the crankcase is of aluminium. With the technologies, which are used to meet the demanding emission limits - for example electrically actuated exhaust gas turbochargers and exhaust gas recirculation valves, EGR cooler, mini-sac nozzle and inlet metered high pressure pump, the new V8 CDI diesel engine is the innovative and technological standard for future Mercedes-Benz passenger car diesel engines. With a power output of 184 kW, the engine is in the top position in the passenger car diesel sector. (Auth)

The new V6 biturbo engine for the Audi RS4

With the new RS4, Audi is continuing its tradition of extremely dynamic estate cars which began in 1993 with the RS2. The basis of this new vehicle is the V6 twin turbo engine adapted from the S4, with a capacity of 2.7 litres and a 40% increase in power output. The specific power output of 105 kW/litre is an absolute peak value for a series production engine. This not only offers the highest level of performance for the RS4 but also means that fuel consumption has been considerably reduced compared with the RS2. The result is a thoroughbred sports car which at the same time offers all the everyday driving suitability of an Audi Avant quattro. (Auth)
Refinement ("Laufkultur") - A domain of BMW powertrain technology

The engines used to drive passenger cars are not merely assessed according to classic characteristics such as thermodynamics, power output etc. Subjective considerations such as refinement, which was previously a term applied to the car as a whole, are becoming increasingly significant. In addition to "sound design", which applies to cars of sporting character in particular, a second dimension is developing which exerts a strong influence on the subjective impression of comfort. Whereas in the first case the customer desires active, stimulating feedback from the engine on a subjective, emotional level, the second concerns itself with the smooth, agreeable manner in which the engine develops its power. (Auth)

Technical progress through evolution - new 4 cylinder gasoline engines by Mercedes-Benz based on the successful M III - Part 1

As a result of the DaimierChrysler merger and in view of a complete adjustment of the brand philosophy, it was necessary to provide an additional, new or at least more attractive 4-cylinder gasoline engine for the Mercedes-Benz model family in the short term. This avoids endangering the long-term plans which have been running for some time in the context of the continuing DaimierChrysler engine strategy. More power, higher torque, good fuel consumption figures and low pollutant emissions - this was how the "platform specialists" formulated its requirements for the engine designers. (Auth)

Technical progress through evolution - new 4 cylinder gasoline engines by Mercedes-Benz based on the successful M III - Part 2

The revised M 1 1 1 four-cylinder spark-ignition engine will be fitted in the new C-class, the SLK, CLK and the E-class. The engine concept and exhaust gas system of the new M 1 1 1 will be presented in the first section of this paper. Moreover, the first part, published in the last MTZ-edition deals with the modifications on the crankcase, cylinder head and valve train, as well as on the mechanical compressor and the oil circuit. (Auth)

Visualisation of high pressure diesel fuel injection into various flow fields

The combustion of clouds of fuel spray is of great importance in many industrial applications, such as gasoline and diesel engines, gas turbines and furnaces. Efficient combustion has to be combined with minimum noxious emissions. However, the interrelated processes of injection, atomisation, vapourisation, mixing, ignition and combustion are so complex that it is still not possible to model them adequately. Experimental studies have been undertaken in idealised, often laminar, conditions and have often revealed only qualitative data. The present study utilised an existing high-pressure, high-temperature turbulent combustion vessel which was equipped with a high pressure diesel fuel injection system. The interaction between the injected jet and the turbulent environment at pressures and temperatures up to those appropriate to diesel engines was investigated. The spray and subsequent mixing and combustion were visualised using a simultaneous combination of Mie scattering laser sheet imaging and Schlieren photography. A video camera recorded the distribution of liquid and gaseous fuel as functions of time and turbulence intensity. The effects of turbulence, pressure and
temperature on jet penetration and subsequent mixing and combustion are clearly demonstrated. (Auth)

Zero emission engine - The steam engine with isothermal expansion
Since the middle of the 1990s, IAV GmbH, Ingenieurgesellschaft Auto und Verkehr, in Berlin has been working on an innovative concept for a SULEV power unit. This development involves an advanced steam engine with a high-performance burner which features extremely low pollutant emission. This report presents the entire project and the current status of work. The forecast section describes the ongoing progress and the planned orientation of the project. (Auth)

COMBUSTION
Combustion system and process optimisation for larger diesel engines with common rail fuel injection
In co-operation with Wartsila NSD and ABB Turbosystems, the Laboratory for Internal Combustion Engines and Combustion Technology (LVV) at the ETH Zurich has optimised a medium-speed DI diesel engine with regard to minimising pollutant emissions in the constant speed, power generation operating mode. To do this, we used a synergetic combination of methods relating both to the air and fuel paths of the engine process. Individual improvement steps include the Miller intake process, a variable geometry turbine (VGT), a new method for cooled EGR at the high pressure side of the turbocharger and a common rail fuel injection system. (Auth)

The new 2.2 l ECOTEC aluminium engine by Opel
The ECOTEC combustion system and the architecture of the new Opel 2.2 l aluminum engine have been configured to achieve low noise and exhaust emissions. This power unit, employed in Germany for the first time in the Astra Coupe, already complies with the Euro IV emissions standard. It features minimum maintenance requirements and a long operating life. The DOHC spark-ignition engine with four valves per cylinder has two chain-driven camshafts, valve gear with roller cam followers and hydraulic lash adjusters. Two chain driven balancer shafts have been integrated into the engine block. The cylinder head and block, lower crankcase, oil pan, and cylinder head cover are all made of aluminum. A modular concept makes it possible to adapt the engine effectively to different vehicle concepts and markets. (Auth)

New approaches to the phenomenological modelling of the gas side wall heat transfer in diesel engines
The gas-side wall heat transfer has been a focal point of research and development on internal combustion engines for many years. The heat transfer is an important marginal condition in thermodynamic cycle calculations and combustion modelling, particularly for the simulation of pollutant formation. While conventional models are capable of providing
**Automobile Abstracts** October 2000 (31/10/2000)

Only spatially averaged information on the wall heat transfer, a spatial and temporal resolution of the wall heat fluxes is desirable for integration into 3D-CFD calculations. Within the scope of a project sponsored by the Deutsche Forschungsgemeinschaft (DFG), new multi-zone approaches which can satisfy these requirements have been developed at the Institute for Technical Combustion at the University of Hanover. The equations presented here are distinguished by their simple handling, even though their physical interpretability was placed in the foreground in the development of the model. (Auth)

EMISSIONS

Comparison of emissions from buses powered by natural gas in real, dynamic driving cycles

A comparison of energy consumption, pollutant emission and noise generated was carried out on three different types of public urban transport vehicles under contract from the Bavarian State Ministry for Commerce, Traffic and Technology by TUV Automotive GmbH in cooperation with the Research Station for Energy Management. A bus powered by natural gas and a diesel-powered bus (Euro 11) with and without a CRT system were thoroughly investigated in real driving cycles. The test vehicles were equipped with extensive mobile measurement instrumentation, enabling the energy consumption and the emissions to be acquired continuously. A mobile exhaust measurement laboratory from TUV Automotive GmbH was used for the detailed observation of the pollutant emissions. (Auth)

Ford and GM: Better MPG with powertrain controls

After barely missing the US Congress’ CAFE (Corporate Average Fuel Economy) standard for trucks (20.7mpg), Ford have announced that it will improve its SUV average fuel economy by 25% within five years. GM have followed suit, by announcing that its SUV fleet would be greener than Ford’s. This news is likely to be welcomed by both environmentalists and customers. The article points out that manufacturers of powertrain control systems and components will also benefit. A text figure shows the powertrain control technologies that will be deployed within and beyond a five year horizon, in order to meet the targets.

The article describes some of the technologies available, pointing out that some have been around for some time, but are more effective owing to faster computers, cheaper memory and better software design tools. Delphi’s involvement in developing electronic throttle control, and Bosch and Delphi’s development of systems based on cylinder deactivation technology are instanced. The likely fuel consumption improvements that the technologies may produce are discussed. Other technologies that are described are valve control systems and new transmissions, such as six-speed automatics and continuously variable transmissions. (RS)

Little gem

Australian engineers have invented an emission control device called a microwave emissions converter. Exhaust gases are subjected to microwaves that break down the gases into a plasma of free ions that then cools to form less harmful substances. The converter works on diesel and petrol engines and can be used downstream of a catalytic converter.
converter to further reduce emissions. The device does leave an increase in the number of tiny carbon particles in the exhaust, but the inventors have developed a way of harvesting the carbon to produce industrial diamonds. (HL)

MKAS - the mobile cold start analyser

The Mobile Cold-Start Analyser, MKAS, is a system for measuring and evaluating the cold-start adaptation of internal combustion engines. Engine-controlled variables, such as ignition signals, injection times or the fuel-system pressure, are measured externally. New parameters such as the opening times for the inlet and the outlet valves, for example, are also calculated. The numerical and graphical evaluation makes a reliable analysis of the cold start possible, thus enabling a quick and target-oriented compilation of data. The MKAS system is designed for mobile use in the vehicle during external testing phases. Its straightforward operation and short set-up times are important features for successful use in practice. (Auth)
ENGINE COMPONENTS - FILTERS

Pressure drop model for ceramic diesel particulate filters
For the application of particulate filters in the exhaust gas aftertreatment of diesel engines, it is important to know the pressure drop behavior as the filter is loaded with soot. For a better understanding of the flow conditions in a ceramic wall flow filter, however, it is important to first study the pressure drop behavior of a clean filter. For this reason, Corning has developed a program which describes the pressure loss in a clean filter with a high degree of accuracy. This model is presented in the following article. It will be shown how this model can be expanded to simulate the pressure drop of lightly soot-laden filters. In a comprehensive parameter study, the influence of cell geometry and length on pressure drop behavior was studied at different flow rates for clean and lightly soot-laden filters.

MTZ 6/2000 01JUL2000, p 24 (5 p, 13 ref)
Index Terms: MODEL/ SIMULATION/ FILTERS/ EXHAUSTS/ AFTERTREATMENT/ DIESEL ENGINE/ Flow
Doc No155054
(in GERMAN and ENGLISH)

New Cargo engine revealed
Iveco has revealed details of its version of the new four and six cylinder engine range developed jointly with Cummins and New Holland. The new engine - the 'Tector' - will power the Cargo range, covering the 6 to 10 tonne gvw sector. Each engine will be available in three power ratings, which are described. Tector will be launched as Euro 3; state of the art engine features are described. (RS)

Truck Magazine October 2000 01OCT2000, p 9 (1 p, 0 fig, 0 ref)
Index Terms: IVECO
Doc No154677

ENGINE COMPONENTS - FUEL SYSTEMS

A bubble-dynamic cavitation model for the simulation of diesel fuel injection systems
This article differs from previous work on cavitation in the fuel lines of diesel fuel injection systems in that it considers the physical properties of the cavitation bubbles. The work is based on a homogeneous two-phase flow in which the influences of density and the speed of sound are considered using bubble dynamics. Various numerical computing methods are used to solve the system of non-linear, partial differential equations. Several operating points are computed in order to verify the usability of the computational method for a pump-line-nozzle system with constant volume delivery. The results show a good agreement between the computations and the measurements of the amount of fuel injected and the pressure development near the pump and near the nozzle. (Auth)

MTZ 7-8/2000 01JUL2000, p 18 (5 p, 14 ref)
Index Terms: FUEL INJECTION/ CAVITATION/ NONLINEAR/ PUMPS/ MODEL
Doc No155047
(in GERMAN and ENGLISH)

Combustion system and process optimisation for larger diesel engines with common rail fuel injection
In the IC Engines and Combustion Technology Laboratory (LVV) of the ETH Zurich and in co-operation with LIEBHERR MACHINES BULLE S.A., we have investigated the potential of common rail fuel injection for heavy-duty diesel engines with regard to meeting future emission standards. Emphasis has been laid so far on the EURO 3 legislation. Using a single-cylinder engine, we have carried out experiments with single and multiple (up to 4)
Automobile Abstracts  October 2000 (31/10/2000)

Injections per stroke. It could be shown that, even with a single injection, the EURO 3 emission levels can be matched, though with a penalty on fuel consumption compared with the EURO 2 engine version; this increase amounts to 2.5 - 4% depending on operating conditions. (Auth)

A common rail concept with pressure modulated fuel injection

Today's common rail fuel injection systems for HSDI diesel engines have a high degree of flexibility. Despite the variety of application parameters provided, there is also a desire to set the rate of injection differently for one particular engine operating point. In particular, a lower injection pressure during pilot injection in contrast to a high injection pressure for the main injection would be advantageous for improving the mixture preparation and therefore the combustion. This article describes the operating principle and achievable injection rates for a pressure-modulated common rail fuel system developed by AVL. Based on single-cylinder tests, the potential for further reductions in emissions is shown. (Auth)

Fuel consumption meters for the future

Common Rail, DGI, return fuel-free systems, automatic engine calibration, unmanned test bed operation and accelerated testing procedures are all challenges that fuel consumption measurement systems will have to face in the future. A new measurement system developed by AVL List GmbH of Graz, consisting of the Fuel Mass Flow Meter and the Fuel Temperature Control, fulfills these requirements. It is unique in combining the advantages of gravimetric fuel consumption meters, i.e. meters based on the principle of weighing, with those offered by flow meters. (Auth)

Optimizing parameters for gasoline direct injection engines

The significance of electronic control units in engine management applications is continually increasing as the automobile continues to develop further as a whole system. Traditional calibration methods fail here because of the increasing complexity of the optimization necessary and the immense testing required to this end. At Robert Bosch GmbH, an innovative method has been developed by which all ECU controller-output variables of relevance to the steady-state stratified operation of gasoline direct injection engines can be optimized. Characteristic for these new methods is the optimization of engine performance using a straightforward analytical computation model. (Auth)

ENGINE COMPONENTS - IGNITION SYSTEMS

Efficient application of electronic control functions for spark ignition engines

The Design of Experiments method (DOE) has firmly established itself as an efficient test method in the development of spark-ignition engines at the company IAV GmbH. In the recent years many projects have been finished successfully using this method. The necessary experiments for engine calibration can be reduced by 90 % and more. In the future the essential scope of stationary data-input tasks will be carried out faster and
cheaper with the aid of DOE. Broad and comprehensive realization for all client projects is presently taking place. In the future engine behavior will be described with clear mathematical models instead of many discrete data points. Thereby duration of engine calibration will be reduced further. (Auth)

Direct cylinder control (DCC) of the air/fuel ratio

In spark ignition engines, DCC allows the air/fuel ratio to be controlled for every single cycle of an individual cylinder as a batch process. Each fuel pulse which is injected during the suction stroke is adapted to the actual air mass entering the cylinder with feed-forward control. During this process, natural gas is port-injected during the suction stroke with immediate and complete transfer into the cylinder. The duration of the on-going fuel pulse is corrected in proportion to a change in the manifold pressure. For individual cylinder feedback control of the airfuel ratio, the signal from a single wide-band lambda sensor at the exhaust confluence point is multiplexed and the true lambda value of individual cylinders is estimated with a simple model-based algorithm. The technical feasibility of DCC was demonstrated with step variations of the throttle and single cylinder fuel pulses. (Auth)

Technical features of the new BMW six cylinder engines

The new BMW range of six-cylinder engines was developed in just 25 months. Achieving the development goals within this extremely tight time schedule was very demanding for all those involved. The aim was to combine a higher power output and increased torque with improved fuel economy and lower emissions. Measures such as increasing the engine's displacement, redesigning the cylinder head and modifying the induction system enabled the development objectives to be achieved. (Auth)

The effect of the intake valve lift of SI engines on mixture formation, fuel consumption and exhaust emissions

At the Institute for Measurement Technology and Reciprocating Machines of the Otto von Guericke University Magdeburg (IMKO), the effect of reduced intake valve lifts on mixture formation, fuel consumption and exhaust emissions has been systematically investigated on a single-cylinder research engine with intake manifold injection and a stoichiometric fuel/air mixture. Laser optic measurements (Phase Doppler Anemometry) on a flow test bench working in stationary operation and calculations using the gas exchange software programme PROMO and the CFD software FIRE, completed the engine investigations. (Auth)
Automobile Abstracts October 2000 (31/10/2000)

Use of gamma titanium aluminide for automotive engine valves

Titanium aluminide is considered an interesting material for the automotive industry when applied to light hot components because of their peculiar properties. In particular the tensile strength which is higher in the 700-800 °C range there at room temperature. Compared with special steel used at high temperature (21-2N) the titanium aluminide is 50% lower in density and the termal expansion is also interestingly lower. A suitable casting technology has been developed with the goal of having a low cost transformation process. Unalloyed TiAL has been proven adequate for automotive valves. (Auth)

Metallurgical Science and Technology Vol 18 No 1 01JUN2000, p 8 (4 p, 4 fig, 3 ref)
Index Terms: VALVES/ TITANIUM ALUMINIDE/ TENSILE/ CASTING
Doc No154628

ENGINE COMPONENTS - LUBRICATION SYSTEMS

The new injection molded centrifugal oil cleaner

The free-jet-driven centrifuge described here is a bypass oil cleaner capable of filtering micro-particles, e.g. soot from oil. At the same time this concept has a very high dirt absorption capacity. Knowledge of the filtration process is vital to predict the impacts of the centrifuge on the dirt content in the engine. By using a centrifuge as a bypass oil cleaner, the interval at which oil needs to be changed can be lengthened considerably (i.e. the amount of soot in the oil) and the volume of particles causing wear in the engine oil can be reduced. Mann+Hummel has been successful in producing the free-jet-driven centrifuge rotors metal-free using injection-molded plastic. This optimizes disposability and reduces material resource requirements. The plastic centrifuge also has much enhanced rotational characteristics even at low oil temperatures and pressures. Market reaction to the centrifuge is highly positive since there is a growing demand for longer oil change intervals. (Auth)

MTZ 5/2000 01MAY2000, p 9 (3 p, 3 ref)
Index Terms: OIL CLEANER/ FILTRATION SYSTEMS/ CENTRIFUGE/ MANN AND HUMMEL/ INJECTION MOULDING/ PLASTIC
Doc No155057
(in GERMAN and ENGLISH)

ENGINE COMPONENTS - EXHAUST SYSTEMS

Cleaning the exhaust gas of Volkswagen FSI engines

In order further to reduce the fuel consumption of their vehicle fleet, Volkswagen AG has decided to develop a spark-ignition engine with direct fuel injection. So as to be able to launch this new engine concept while at the same time meeting the EU IV emission standards, it was necessary to develop a suitable exhaust gas aftertreatment system, and this was achieved as part of an intensive co-operation between Volkswagen AG and dMC2 Degussa Metals Catalysts Cerdec AG. The following article describes the exhaust gas aftertreatment system for Volkswagen FSI engines, its adjustment to the vehicle and the most important development aspects. (Auth)

MTZ 6/2000 01JUN2000, p 19 (5 p, 4 ref)
Index Terms: VOLKSWAGEN/ SPARK IGNITION ENGINES/ DEVELOPMENT/ DIRECT FUEL INJECTION/ EXHAUST GAS/ DEGUSSA METALS CATALYSTS CERDEC/ AFTERTREATMENT SYSTEM
Doc No155053
(in GERMAN and ENGLISH)

Diminishing conflicting goals between effective sound attenuation and low exhaust backpressure

The technical development of a new exhaust system is significantly determined by sound attenuation problems. One of the major challenges is to effectively attenuate the sound in different frequency ranges without reducing the engine power. Friedrich Boysen GmbH & Co. KG in Altensteig, Germany, has developed an exhaust system which combines a Helmholtz resonator and an exhaust flap. The system is to be used for the first time in a series production car in 2001. A patent for the system has been applied for. (Auth)
The exhaust system of the new BMW X5

With the XS, BMW has introduced a completely new class of vehicle which first became available with the V8 engine already used in the 740i and 540i models. The innovative concept of a “Sports Activity Vehicle” (SAV) meant for the manufacturer’s transmission development area in particular the retention of advantages typical of the brand, such as dynamism and driving pleasure, but also the provision of convincing technical solutions in view of the new challenges such as off-road capability and universal use. The X5's exhaust system was developed under these preconditions and a product that meets the vehicle's requirements thus brought to series maturity. (Auth)

Lean but keen

Faurecia has developed a new exhaust system that will work more effectively with lean-burn engines and reduce fuel consumption. The company has developed a system that contains an air/gas exchanger that uses natural convection of the under-body air to cool the exhaust gases. Several exchanger alternatives are described and the importance of dynamic control of the system discussed. (HL)

Mechanical and acoustic optimization of exhaust systems: New development methods using CAE

The development of modern vehicles has grown into an increasingly demanding task. While development times have become shorter, the requirements for the components have become more complex. This trend also applies for the development of exhaust systems. In this area, the great number of variants complicates the goal of cutting down on development times. For every engine/vehicle combination a new exhaust system has to be designed. New analysis procedures have been developed at the Institute for Combustion Engines at the RWTH Aachen in cooperation with FEV Motorentechnik to save time and costs in the development process of exhaust systems. (Auth)

BATTERIES, FUEL CELLS AND FLYWHEEL TECHNOLOGY

Switched reluctance motor drives reach serious candidacy for electric and hybrid electric vehicle traction

This article summarises research into switched reluctance motor (SRM) drives at Texas A&M University's Advanced Vehicle Systems Research Program (AVSRP). The finding that initial acceleration and gradeability demand an extended constant power region in the motor torque speed plane, can be interpreted as a method to reduce the power rating of the motor drive, producing a more compact drivetrain for electric and hybrid vehicles. A research report concluded that SRM drives, if properly designed and controlled, can provide all the vehicle requirements for vehicle traction while demonstrating low-cost, reliable, compact and highly efficient performance.
The article describes a bench-scale SRM drive developed by the AVSRP to investigate electric vehicle and hybrid electric vehicle traction applications, and outlines the AVSRP's reported results. Two figures are provided showing the magnetic characteristics of the SRM. (RS)

USABC outlines future R&D for NiMH and Li-ion batteries
This article focuses on the work of the United States Advanced Battery Consortium (USABC). Currently the USABC is focusing on nickel-metal hydride (NiMH) and lithium-ion (Li-ion) battery technologies. The article summarises NiMH achievements and looks to future areas of NiMH development. The article then moves on to consider Li-ion research, particularly the development of the Lithium-polymer thin-film cell. (RS)

Why solid hydrogen storage will work for fuel cells
This article considers what it regards as a breakthrough in fuel cell technology - solid hydrogen storage - developed by Energy Conversion Devices (ECD). Recent developments in the storage of hydrogen in metal-hydride matrices now allow the storage of sufficient hydrogen to power a fuel cell electric vehicle (FCEV) several hundred miles. The operation of the metal hydride matrix is described, and a figure is provided. This method has the advantage of operation at low pressures, without the need for energy intensive liquefaction processes. The safety testing of the matrix is described. The article ends by describing ECD's patent position and interest of Texaco Energy Systems in the development. (RS)

TRANSMISSION
A high-tech transmission
Easytronic, a 'robotised' five-speed manual gearbox in the new 1.2-litre Opel Corsa, has the advantages of both automatic and manual transmissions. It has taken LuK and Bosch three years to develop the system which weighs only four kilos more than a manual gearbox. The driver can choose whether to change gear manually or automatically, and can go from one mode to the other by just pushing the gear lever to the left. Manual gear-changing is effected by pushing or pulling the lever towards 'plus' (up) or 'minus' (down) without taking the foot from the accelerator pedal. If the driver needs more power in manual mode, to overtake for example, there is a 'kick-down' option which is engaged by depressing the accelerator completely. In automatic mode the economical average fuel consumption is 6.3 litres per 100km. (CP)
pitting failure. The investigation result clarifies the effects of nitrogen and shot-peening on the resistance to softening during tempering, on the pitting endurance, and the relationship between them. On the basis of the results, a new automatic transmission gear with teeth having high contact fatigue strength has been developed and manufactured on the commercial base. (Auth)

Multitronic - The new automatic transmission from Audi: Part 1
Customers expect improved performance and greater comfort and convenience in combination with reduced fuel consumption and exhaust and noise emissions, and therefore new concepts are needed in the transmission area as elsewhere. Audi satisfies these requirements with the newly developed multitronic automatic transmission. Based on the continuously variable ratio concept, multitronic combines the convenience of modern automatic transmissions with the dynamic character and economy of a manual-shift gearbox. Part 1 of this article describes the mechanical and hydraulic transmission concept, while Part 2 describes the control systems. (Auth)

Multitronic - The new automatic transmission from Audi: Part 2
The multitronic from Audi combines the convenience of modern automatic transmissions with the dynamic character and economy of a manual shift gearbox. Part 1 described the mechanical and hydraulic transmission concept, while the following part 2 describes the control systems. (Auth)

Test automation and powertrain modelling on HIL control unit test rigs in the BMW transmission development department
The demands made on the functions of new automatic transmission generations are increasing constantly. The main emphasis is on the introduction of mechatronic system components and the rapidly increasing degree of networking of the transmission assembly within the vehicle. This leads to an enormous increase in the functions of electronic transmission control systems. Contrasting with this is the demand to reduce development time and development costs. In this context, the utilisation of new development methods and simulation procedures is one of the most important requirements for success in the future. This article deals with the two main topics of real time modelling and test automation, which are successfully used in the automatic transmission development department of the BMW Group. (Auth)

Shift of opinion
The article presents test results of the four top auto and semi-auto truck transmissions. The article gives some background to the development of auto and semi-auto truck transmissions and summarises the benefits of modern systems: less reliance on skilled drivers; benefits to fleet average fuel economy, and driveline protection. The four models tested were the Scania R144.460 (with Opticruise transmission); Iveco Ford 440E39TXP (with ZF semi-auto Eurotronic shift); Mercedes Benz 3540LS (Autotrans transmission), and Volvo FM12.380 (Geartronic mk2). All the vehicles were powered by their latest
Automobile Abstracts October 2000 (31/10/2000)
electronically controlled engines, except for the Scania which used electronic engine management but not the full CAN controlled engine. A brief comparison of each vehicle is tabulated.

The article describes the test conditions applied to the four vehicles. The article also gives a detailed description of how each transmission system is operated (a comparison of each transmission specification is tabulated). A figure is included for each vehicle showing photographs of the cab interior and details of the transmission controls. The driving impressions are reported for each of the test vehicles. The results of the test are summarised in a table under 'logic', 'ease of use', 'impression', 'rating', and lists positive and negative points. The Iveco semi-auto system was thought to be about the best around, but of the full auto systems it was a close call between Mercedes or Volvo. The article finally settles on the Mercedes system, helped by the fact that it is currently a no-cost option. (RS)

Truck Magazine October 2000 01OCT2000, p 50 (8 p, 7 fig, 0 ref)
Index Terms: AUTOMATIC TRANSMISSIONS/ IVECO FORD TRUCK/ MERCEDES-BENZ/ SCANIA/ VOLVO TRUCK
Doc No154672

ZF adds light auto
ZF is planning the introduction of a lightweight six-speed ASTronic automatic gearbox for the light and medium weight truck sector in 2003. ZF's analysis is that by 2007 50% of the light duty commercial vehicle market will be equipped with automatic transmissions. ZF's ASTronic transmission has entered service with MAN, and may shortly be introduced to Iveco with the new Cursor 13 engines. (RS)

Truck Magazine October 2000 01OCT2000, p 13 (1 p, 0 fig, 0 ref)
Index Terms: ZF/ MAN/ IVECO FORD TRUCK
Doc No154678

AXLES, TRACTION CONTROL AND POWERTRAINS

Analysis of polyester and epoxy composite shells subjected to axial crushing
Round cylindrical and conical shells made of short randomly oriented glass fibre mats with polyester resin and tubes made of 0/90 continuous glass fiber mats with epoxy resin were subjected to axial compression in an Instron machine. The different failure modes of these shells and their energy absorbing characteristics were studied. Based on the experimental observations, an analytical procedure is established to predict the post collapse load-compression characteristics of the composite shells. Analytical expressions were obtained to predict the average crush stress and the crush length in a crush cycle for the composite conical shells as well as for the cylindrical tubes. The results thus obtained were compared with the experimental values as well as with the results available from the literature. Good agreement is found. (Auth)

International Journal of Crashworthiness Vol 5 No 3 01SEP2000, p 333 (12 p, 7 fig, 15 ref)
Index Terms: AXIAL/ POLYESTER/ EPOXY RESIN/ INSTRON MACHINE/ SHELLS/ ENERGY ABSORBING/ EXPERIMENT/ CRUSH/ COMPOSITE/ TUBES/
GLASS FIBRE MATS
Doc No155512

Axial collapse of hybrid square sandwich composite tubular components with corrugated core: Experimental
Experimental results pertaining to the static axial loading of hybrid square rail vehicle tubular components, made of foam-cored composite sandwich panels with integral energy absorbing inserts, are reported. The structural configuration tested is the "corrugated" core system. Failure modes at macro- and microscale and the energy absorbing of the collapsed structural components are presented. The crashworthy behaviour of these small-scale body shells seems to be greatly affected by the structural design and the material properties of the composite sandwich components. The effect of diverse triggering conditions ("chamfer" and "tulip" triggering structures) at one end of the specimens tested
Experimental investigation of unsteady flow phenomena in a three stage axial compressor with CDA

In the field of multi-stage axial compressors, a lot of research is focused on increasing efficiency and extending operating ranges. Sophisticated and reliable design tools are necessary so that all relevant aspects of the complex viscous and unsteady flow can already be considered during the design process. The development of such tools is dependent on experimental data which has to be collected from expensive measurements in quasi-industrial test compressors. Therefore, a three-stage axial compressor with CDA was built at the Institute for Jet Propulsion and Turbomachinery of the University of Aachen and studied in detail by means of different measuring techniques, with time averaging and with a high resolution in time. (Auth)

The new Unimog generation - Part 1

The Unimog series U 300, U 400 and U 500 are the latest logical progression in a technical concept which has proved its merits around the world over a period of almost 50 years, in which time more than 310,000 vehicles have been sold. A modern four wheel drive implement carrier suitable for off-road applications has to fulfil high demands in terms of comfort, economy, safety and environmental compatibility. The new Unimog generation fully meets these requirements. The first part of this report covers the development methods and the driveline. (Auth)

Alternative alternator

Bosch has developed a new alternator range that promises up to 25 percent output and 74 percent more efficiency over existing technologies, without an increase in size. The LI-E range combines advanced electrical circuitry and the application of new manufacturing materials. (HL)

Compact alternator delivers more power

Bosch's new LI-E Compact alternator range combines advanced electrical circuitry with the use of lightweight materials to give higher power output and improved efficiency. The new alternator also contains a multi-functional single chip voltage regulator, which guards both the alternator and on-board electrical systems against abnormal voltage peaks. (HL)
Optimising electrical system architecture using genetic algorithms

Control units in vehicles are increasingly being networked. Framework conditions, for example the cost of network nodes, change so rapidly that an optimised network rarely survives one model generation. This article describes the possible applications of a genetic algorithm which can be used to optimise the architecture of the datanet quickly and easily.

(Auth)

Moving up to 42-Volt systems

Most carmakers agree that future electrical systems will be powered by 42 Volt batteries. This news article reports that Norman Traub of Delphi will present several alternative electrical architecture solutions for consideration as part of a key note speech at this year's International Symposium for Automotive Technology and Automation.

A summary of ITS evaluation facility

Matsushita Communication Industrial Co. Ltd., has "ITS Evaluation Facility in Hanamaki City", as one of ITS projects in order to strengthen marketability and adjustability to users. In this facility we can test and evaluate various kinds of automotive products ranging from ETC system to sensors. This facility is one of the best and largest in electrical and communication components manufacturers. (Auth)

A market weighted description of low beam headlights patterns in Europe

This study was designed to provide photometric information about current European low beam headlamps. The sample included 20 low beam headlamps manufactured for use on the 20 best selling passenger vehicles for calendar year 1999 in 17 European countries. These 20 vehicles represent 47% of all vehicles sold in these countries. The lamps were purchased directly from vehicle dealerships, and photometered in 0.25º steps from 45º left to 45º right, and from 5º down to 7º up. The photometric information for each lamp was weighted by 1999 sales figures for the corresponding vehicle. The results are presented both in tabular form for the 25th percentile, the median (50th percentile), and the 75th percentile luminous intensites, as well as in graphical form (for the median luminous intensities). (Auth)

Electro magnetic wave anechoic chamber with equipment for three dimensional measurement

Radio terminals, such as car telephones and personal handy phones, require small antenna. As the antenna gets smaller in size, it is more strongly influenced by the surrounding. As a result, the antenna performance is degraded, and the characteristic gets complicated. To understand the whole of its characteristic, we had built equipment for
measuring the three-dimensional antenna gain and directivity including metallic conductors and a human body placed near the antenna. (Auth)

Journal of Society of Automotive Engineers of Japan Vol 54 No 6 01J UN2000 p 36 (5 p, 10 fig)
Index Terms: RADIO TERMINALS/ TELEPHONES/ AMTENNA/ PERFORMANCE/ THREE DIMENSIONAL/ Conductors/ ELECTRO MAGNETIC/ ANECOHIC
Doc No155492
(In JAPANESE)

Flat belt driving simulator
The visual system of a flat-belt type driving simulator has been totally renewed to improve the reality and traffic generation capacity. The display capacity of an image generation workstation was increased from the conventional 310 000 pixels to 1.2 million pixels. Through the increased capacity, it has been made possible to realize a vivid and highly realistic image which is visualized on a curved forward-view screen using a high-resolution projector. The display system was also combined with a traffic flow simulator that generates surrounding traffic, and the integrated system is capable of displaying constantly changing traffic situation. The new simulator has played an important role in bench tests for the Advanced Safety Vehicle and other ITS systems. (Auth)

Journal of Society of Automotive Engineers of Japan Vol 54 No 6 01J UN2000 p 49 (5 p, 9 fig, 5 ref)
Index Terms: FLAT BELT/ SIMULATOR/ BENCH TEST/ DISPLAY SYSTEM
Doc No155495
(In JAPANESE)

Numerical modelling as a tool for cost effective design and optimisation of EMC test chambers
The absorbing materials that are used to minimise wall reflection in EMC test chambers represent a significant proportion of the cost of such facilities. Thus, there may be significant economic benefits in minimising the absorber requirements, either by partial lining schemes or by reducing the dimensions of the chamber. This paper demonstrates the success of numerical modelling techniques in predicting the behaviour of cavities lined with ferrite tiles, for both fully and partially lined arrangements. The merits of combining ferrite tile and foam based absorbers are also assessed. It is concluded that numerical modelling techniques now represent a viable approach for optimising the design of EMC chambers in terms of both performance and cost criteria. (Auth)

4th European EMC Symposium Brugge, 11-15 September 2000 11SEP2000,
Index Terms: EMC/ REFLECTION/ FERRITE TILES/ ABSORBING MATERIALS
Doc No154545
(Not available for supply)
HYDRAULIC FLUIDS

How clean is your hydraulic fluid?

With down time becoming more expensive, and with hydraulic systems becoming more sophisticated, reliability and fluid cleanliness of hydraulic systems is becoming more important. This article surveys hydraulic system testing methods and particle detection equipment. The article concludes with a discussion of the importance of fluid filtration. (RS)

COOLANTS

Coolant-cooled charge air coolers for motor vehicle engines

Charging with cooled charge air is used in almost all diesel engines and increasingly in spark-ignition engines. It serves to increase the power density and reduce the emissions and fuel consumption of the engine. Compared with current air-cooled systems, with the new coolant-cooled charge-air cooling the pressure drop on the charge-air side is reduced, space is saved at the front of the vehicle and the response times are reduced. This article describes the concepts for coolant-cooled charge-air cooling and new designs for air-to-coolant charge-air coolers and the advantages by means of a number of examples. (Auth)
Aluminum properties, a model for calculating mechanical properties in AlSiMgFe-foundry alloys

A semi-empirical model named ALPROP has been developed for the calculation of tensile properties and hardness in AlSiMg(Fe) foundry alloys. With chemical composition, dendrite arm spacing (DAS) and heat treatment parameters as input the model calculates tensile properties and hardness for material in as cast, solid solution heat treated and in artificially aged condition. The model, which takes into consideration the relationship between the different input parameters and the link to basic metallurgical features, shows good agreement with experimental results. The ALPROP model has proved to be a useful tool for tailoring mechanical properties by correct choice of chemical composition and process parameters, for analysing consequences and identifying possible actions when having unintended process variations, identifying improvement potentials and for training of foundry staff. (Auth)

A consideration on accepted opinion for proof testing in ceramic materials

It has been accepted not only that effective proof testing of ceramic materials demands rapid loading and unloading to prevent strength degradation but also that especially rapid unloading results in a truncation strength of (the stress just before very rapid unloading). Such an accepted interpretation in proof testings as above has been rechecked from an analytical point of view. The analysis reveals that as the loading and unloading rates increase, weaker samples tend to survive more easily. As a consequence, the truncated strength is not characterised analytically, and the Weibull curve will not have asymptote. The present analytical results come to the conclusion that the established theory in proof testing can not be accepted from the physical point of view. (Auth)

Design and fabrication of TiC-based symmetrically compositional functional graded materials

TiC-based cermets with Ni-Mo alloys are now increasingly used in industry. For further improving the properties of TiC-based cermets with the aim to replace more kinds of WC-based cemented carbides, TiC(Mo, Ni)x/TiC(Mo, Ni)y/TiC(Mo, Ni)x symmetrically compositionally functional graded materials (SCFGM) are proposed and fabricated, which have the following advantages: (1) more wear resistant surface layers composed of less Ni-Mo alloying in combination with tougher mid-layer(s) composed of more Ni-Mo alloying; and (2) artificial residual compressive stress created on both surfaces of the specimen due to the difference in the thermal expansion coefficient between surface layers and mid-layer(s), which remarkably increases the bending strength and the fracture toughness of the SCFGM. The analytical model for SCFGM is established based on elasticity mechanics, mechanics of composite materials and computing mathematics. Triangle series are employed to describe distributions of residual thermal stress on both surfaces of the FGM caused by the difference in thermal expansion coefficients between surface layers and central layers. As an example, TiC-based SCFGM is successfully fabricated based on calculated thermal stress distribution by the self-developed SCFGM CAD system. (Auth)
Automobile Abstracts October 2000 (31/10/2000)

Development of mixed (ferrito-ausferritic) structures for spheroidal graphite irons

For years in the automotive industry the objective is to reduce the weight of components for well known car performance and environmental reasons. One way is to use more resistant materials for instance in the area of suspension foundry castings. Austempered Ductile Iron (ADI) is one of the most unique materials due to its particular mechanical properties. Some tests have been made on chassis parts like front knuckles which have confirmed the good mechanical results obtained about the tensile strength and elongation. Nevertheless, the impact test results can be improved by some metallurgical structure evolution. The combination of fettitization and ausferritization heat treatments for nodular SG irons should lead to a good compromise of characteristics between yield strength, elongation and impact test. The paper describes some of the works made according to this target acting on chemical and heat treatment parameters. Micrographic structures and mechanical properties obtained are shown. A comparison with existing ADI grades is established. Different structures and associated characteristics are described which allow to imagine a first orientation for chassis applications. Making use of a dilatometer several tests have been run to define properly the quality of the structures. (Auth)

Metallurgical Science and Technology Vol 18 No 1 01JUN2000, p 24 (6 p, 12 fig, 5 ref)
Index Terms: WEIGHT/ COMPONENTS/ MATERIALS/ CHASSIS
Doc No154945

Ecomaterials research in China

China has been developing its economy with a speed that it never experienced before and has achieved progress that attracts worldwide attention. However, as its large population and the pressures from resources and environment are constraining its economic and social development, China firmly chose the route of sustainable development. China's material experts have been pondering over ecological and environmental problems throughout the process of material design, fabrication, application, disposal and recycling. In recent years, the applied fundamental research on ecomaterials has been underway through the priority foundation project of the National Education Committee, NSFC and project of China's High-Tech. 863. Chinese Ecomaterials Society, and the Chinese Center for Materials Life Cycle Assessment (CCMLCA) are now being established. With the guidance and support of the government, our material researchers are now carefully drawing up a sustainable material development plan that is suitable for China's situation and carrying out extensive studies on ecomaterials science research and development of ecomaterials. (Auth)

Materials & Design Vol 22 No 2 01APR2001, p 107 (4 p)
Index Terms: CHINA/ RESEARCH AND DEVELOPMENT/ MATERIALS/ ECOLOGICAL/ ENVIRONMENTAL/ DISPOSAL/ RECYCLING
Doc No155621

Effect of addition of multifunctional monomers on one-step reactive extrusion of PP/PS blends

One-step reactive compatibilisation of PP/PS alloys was studied by using a twin-screw extruder in the presence of dicumyl peroxide (DCP). Compared with mechanical extrusion, reactive extrusion greatly reduced the average dispersed particle size, due to the formation of PP-g-PS graft copolymers, which behave as in situ formed compatibilisers. In order to suppress the degradation of the PP chain during the process, some multifunctional monomers such as GTL, TMPTA, DEGDA, TPGDA were added in combination with DCP. By studying the effect of the monomers on the MFR and the morphology of the resulted blends, it is found that the flexibility of the additive molecules and the reactivity of the double bond of carbon contained in the molecule are crucial for the grafting reaction. The suppression of PP degradation depends on a certain amount of double bonds. (Auth)

Materials and Design Vol 22 No 1 01FEB2001, p 11 (4 p, 5 fig, 7 ref)
Index Terms: MATERIALS/ POLYPROPYLENE
Doc No155268
Effects of crystalline morphology on the impact behaviour of polypropylene

A series of notched impact tests were made to polypropylene (PP) materials of different crystalline morphology through a certain effective filled nucleating agent (0.1-2 wt.%) and subsequent heat-treatment. A maximum of impact strength exists at the 0.4 wt.% filled quantity of the nucleating agent. It was shown that when the filled quantity of the nucleating agent was below 0.4 wt.%, the spherulite size decreased and the crystallinity increased. The impact strength was controlled mainly by the spherulite size, but when it went beyond 0.4 wt.%, the decline tendency of the spherulite size decreased and tended towards progressive stabilisation, the crystallinity still increased and the rising gradient increased. Therefore, crystallinity is the decisive factor in strength property. This illustrates that the appearance of a maximum of impact strength is due to the comprehensive result of the spherulite size and the crystallinity. The succeeding heat-treatment only affected the crystallinity. The spherulite size showed basically little change. The impact strength can be described by a quantitative formula. The fracture surface was composed of the expanding zone, the arc stripe zone and the last fracture zone. The fractal dimension of the expanding zone exists at a maximum at the 0.4 wt.% filled quantity of the nucleating agent. The size of the arc stripe has nothing to do with the quantity of nucleating agent. (Auth)

How well can physical, chemical, and mechanical properties of materials be predicted by ab initio techniques?

Ab initio treatment is becoming a realistic method of predicting various properties of industrial materials of interest. One method is to up-grade the approximation levels according to the electron gas theory beyond local density approximation. Another is to extract necessary parameters from the ab initio calculations for a limited number of atomic systems and apply these numbers into cluster variation, directly, or by other methods. In this paper, several typical examples are introduced which indicate that it is possible for these methodologies to be successfully used based on the present state-of-the-art supercomputing systems. (Auth)

Improved thermally stimulated current techniques and quenching polarization of polypropylene

Step heating TSC as well as bound charge and residual charge measurements were performed in polypropylene (PP) to give static TCS spectra. All the results demonstrated good agreement of a -15°C temperature shift relative to the spectrum of normal TSC at a rate of 2°C/min. By carefully examining the discharge sources, a charging method was proposed to study the variation of stored polarised charges on the quenching process. The quenching polarisation current showed a charging peak. The reason for this was that the structure or configuration of the polymer at a high temperature is kept at a lower temperature and this structure can hold more bound charges in the lower temperature than in the higher temperature. Thermal-cycle polarised TSC measurements further show that some bound charges enter into deeper energy levels in the quenching polarisation process. This result provides a better means of polymer preparation and shows the danger of using the polymer in a high DC field or radiation conditions. (Auth)
Modelling of very high concentration effects on impurity diffusion in semiconductors

The standard theory of dopant diffusion in semiconductors based on the reaction-diffusion equations is generalised to include 'many body effects' due to the presence of a very high concentration of immobile dopants. This new formulation makes it possible to calculate the concentration profiles of donors/acceptors, clusters, and precipitates, if any, both in silicon and semiconducting compounds in good agreement with the experiment. Moreover, it is possible to calculate the effective diffusion coefficient within the steady-state approximation. This approach has been used to calculate the explicit form of the effective diffusion coefficient in predoped semiconductors. Furthermore, simple analytical formulae are given for, respectively, dopant in-diffusion profiles and the maximum penetration depth. (Auth)

Modular simulation technique for virtual experiment of complex phenomena in materials

Collaborative materials design largely depends on the quality and utilization methodology of available information resources, and materials data systems play a central role in the beginning to set-up strategies of using such data systems to reach a design solution. One of the key issues in carrying out a strategic design of materials concerns establishing the interoperabilities of materials data systems, which are treated as syntactic and semantic discrepancy problems. In this paper, the syntactic difference is treated briefly at first. Next, the critical issue of semantic interoperability is addressed, and further characterised by introducing a level of detail of the physical modelling. It is shown that each interoperable object should correspond to a certain physical model with a varying level of detail. Hence, the problem of interoperability could be transformed into a problem of semantic impedance, fitting the variety of physical models and available datasets. Finally, for a future perspective on material design processes, a virtual experiment of materials is given as an essential interface to materials through Q/A to/from 'artifacts' of materials in computers. (Auth)

Sequent and accumulative life cycle assessment of materials and products

In this paper, a method of sequential and accumulative life cycle assessment for materials and products, and the concept of whole life cycle assessment (WLCA), are proposed. Some fundamental considerations for materials life cycle assessment (MLCA) are discussed. Also, the LCA software based on these ideas is introduced. (Auth)

Studies on the impact fracture behaviour of flame retardant polymeric materials

Two commercial flame retardant (FR) additives, a brominated phosphate ester/antimony trioxide mixture and a magnesium hydroxide were added up to 30 and 60% by weight to polypropylene matrix, respectively. The impact behaviour of the PP/FR composites were studied by the Charpy impact test and the impact fracture toughness (Gc) measurement. As the amount of FR increases, the impact properties decreased accordingly. Such behaviour is strongly related to the morphologies and was investigated by means of scanning electron microscopy (SEM). (Auth)
**FERROUS METALS**

**Computer simulations of phase transformation in steels**

A comprehensive computer system for the material design of HSLA steels as been set up. As one sub-system, the phase transformation module was fundamentally set up based on the classical thermodynamic and kinetic theories. THERMO-CALC and DICTRA programs were used to construct the frame of the module. The γ → α phase transformation and the precipitation of microalloy-elements in austenite and during or after the transformation to ferrite in some steels were simulated. The results, compared with the experimental data, were satisfactory. (Auth)

**Development of environmentally conscious steel products at the Nippon Steel Corporation**

Global environmental problems, including global warming, are extremely important and urgent issues for humankind. The human society that has pursued and enjoyed only the development of global civilization now faces the challenging proposition of sustainable development. In recent years, Japan’s steel industry has positioned global environmental compliance as an important objective in corporate activities and has taken various initiatives to contribute to this sustainable development. These environmental initiatives can be considered in three main categories: (1) reduction in CO2 emissions and energy consumption; (2) promotion of recycling and zero-waste; and (3) environmental protection and environmental improvement. Based on this concept, Nippon Steel has implemented environmental measures for steel production processes and has promoted the development of various environmentally friendly products to meet the requirements of diverse consuming industries. The initiatives launched by Nippon Steel in the development of environmentally conscious steel products (eco-products) for each kind of steel market are introduced here. Representative eco-products that meet the requirements of these industries are described. The 21st Century is said to be the ‘century of environment’. Steel will be continued to be utilized as an eco-material in the next century. Nippon Steel will make great contributions to global environmental protection as an ‘eco-company’ with ‘eco-products’ and ‘eco-processes’. (Auth)

**Development of iron and steel into eco-material**

The technology of ferrous metals is well established. The use of iron and steel, in particular, is considerable and widespread. However, the processing of these materials is resource intensive and generates considerable pollutants, despite continual development. To maintain the use of these popular and versatile materials in the future will necessitate an increased attention to reductions in the consumption of natural resources and power, and greater sensitivity to the environment. This paper presents guidelines for ecological design of engineering product and processing of iron and steel in order to encourage greater processing and recycling efficiencies. It also describes the use of life-cycle analysis as a technique to assess the impact of change on society. The techniques are illustrated through the application of automobile manufacture and use. It goes further to stress the importance of relevant education in the principles of edodesign as fundamental to the effective implementation. The paper concludes with recommendations for the future. (Auth)
Deformation behavior of steels in mushy state

Processing metals in a semisolid or mushy state has emerged as a vital commercial process to produce metal and metal-matrix composite components. The understanding of the basic deformation behavior of materials in the mushy state is critical for better control of various semisolid processes. The aim of the present study is to quantify the flow stress of mushy-state steels under uniaxial deformation conditions. A hot compression tester has been developed to provide the high temperature setting required for testing mushy-state steels. An analytical scheme, which only requires measuring the dimensions of the final solidified specimen, has been developed to eliminate the barreling effects occurring in compression tests. The temperature of specimens has been carefully controlled to correlate the solid phase content. It has been found that the flow stress of steels in mushy states was highly dependent on the solid phase percentage. The relaxation of steel and stress reduction at mushy states is also discussed. (Auth)

Mechanical behaviour of 6082-T6 aluminium alloy welds

In the utilisation of aluminium alloys for structural applications, one difficulty to be overcome is the reduction of mechanical properties of welded joints as compared to the parent material, consequent upon the weaker strength of the Weld Metal (WM) and the deterioration in the Heat Affected Zone (HAZ) due to welding thermal cycles. In this paper the microstructure and mechanical characteristics of joints welded with Gas Metal Arc Welding (GMAW) procedure, made of plates of 6082-T6 alloy, are investigated. Experimental work included Vickers microhardness test, tensile test, fatigue rotating bending test, Charpy V impact test and Scanning Electron Microscopy (SEM) fractography. Diagrams of fatigue stress - cycles for parent and welded material were compared. Static tensile tests showed minimum value in the WM. Fracture toughness in terms of $K_{ic}$, estimated by empirical relations, showed the lowest value in the melted zone. (Auth)

Thixoforming of aluminium alloy for weight saving of a suspension steering knuckle

The employment of light alloys aimed at weight saving is becoming a stringent need in the transport industry due to the environmental and social pressure. Fuel consumption and exhaust emissions are in fact strongly dependent on car weight and for such a reason, the automotive industry is looking at both innovative process technologies which make use of light alloys and new design methodologies. On such a base, after a brief analysis of the approach to be adopted for meeting the environmental goal, the paper describes the development of a suspension steering knuckle through the application of thixoforming technology of an aluminium alloy. It is described the methodology which was used for material/technology choice and component optimisation. A previous solution made of cast iron. Prototypes of the optimised steering knuckles were manufactured by using a thixoforming Buhler machine. The following metallurgical analysis and bench testing demonstrated the suitability of thixoforming process for the development of aluminium safety parts. (Auth)
Lear launches two new materials
The Lear Corporation have developed two new polymer materials, a natural fibre acrylic and a natural fibre polypropylene, for use in future door panels, pillars and boot trim. The lightweight natural fibre acrylic incorporates a modular binding system that will allow stiffness and impact resistance to be varied according to need. The natural fibre polypropylene has superior elasticity, providing high impact resistance. (HL)

Plastic parts shine brightly with style
Car-makers and plastics suppliers are beginning to experiment with plastics that fluoresce. One application for these luminous materials could be to meet the requirements of proposed legislation that interior door handles in cars must be clearly discernible even in total darkness. (HL)

Plastics in car production Part 2: Coating and surface treatment
Because of their extraordinary versatility, plastics offer many applications in automotive design. In the first part of the article, in the March edition of ATZ, the use of plastic materials in car production was described from the point of view of chassis, body and engine components. In this second part, the surface treatment of plastic body components is discussed. (Auth)

The search for stiffness
This article looks at current work into improving the stiffness of thermoplastics that are used by the automotive industry in moulded parts. It covers the use of additives but concentrates on fibre reinforcement and long fibre moulding technology. The physical properties, including tensile strength and flexural modulus, of various commonly-used reinforcing fibres and typical long fibre thermoplastic compounds are given. Results of one leading technical compounders tests on a selection of die-cast metals compared with a long glass fibre reinforced polyamide compound are given. The tests showed, that within certain boundaries the compound showed reasonable tensile strength, high impact and good elongation, flexural modulus was however low. Developments in sandwiched structures such as the Mercedes A-class tailgate that is moulded as two shells which are then bonded together, and metal plastic hybrids such as the grille opening reinforcement developed jointly by Ford, Visteon and Bayer are described. (HL)

The status of recycling of waste rubber
The significance of recycling of waste rubber in protecting the environment and conserving energy is discussed. Various kinds of recycling approaches to waste rubber are summed up, such as reclaiming energy as fuel, reuse of the products of thermal decomposition, cleaning of leaking oil, reuse after simple modification, regenerative rubber and powdered rubber (PR). Recycling as PR is covered in more detail. Classification and modification of PR are also mentioned. According to the particle size of PR, it may be classified as rough
PR, fine rubber powder (FRP), tiny PR and ultra-tiny PR and so on. Each has a different production approach and can meet different applications. Activated PR and FRP have a wider application field than common PR. Many products of recycled powdered rubber are listed. (Auth)

The strain generated on a rubber surface in the course of pattern abrasion

The surface strain on a rubbing rubber surface was examined in the course of pattern abrasion. Rubbing experiments between the outermost surface of a rotating isoprene rubber wheel and a cylindrical lens were conducted. Observations of the contact area were made through the lens. Markers were put on the rubbing rubber surface to measure strain. The maximum strains at the inclined rubber surface between the ridges were from around 40% to 100%. In order to measure the strain at the crack-propagating area, a marker was put on the lower front part of the ridge. It was found that the strain necessary for crack propagation underneath the ridge was 75%, which was almost equivalent to its breaking strain, irrespective of the applied load. At that moment, newly generated crack surface was confirmed. However, no visible crack was observed through an optical microscope when the strain was measured at 200% to 400%. (Auth)

Tire cord shape influence on stresses using a micromechanics model

This paper investigates the influence of cord shape in cord rubber composites using a three-dimensional micromechanical model. The micromechanical model integrates a solid rubber finite element with a twisted cord finite element that takes into account various coupling effects. The developed micromechanical model is used to investigate the effect of cord shape on deformations and interface stresses. Numerical results of deformations and stress distributions are presented to illustrate the influence of cord shape, cord properties, loading, and rubber thickness. (Auth)

Application of the flash method for the thermal characterisation of woven carbon fibre laminates

An application of a reliable method to measure the thermal diffusivity of woven carbon fibre laminates is presented in this paper. The thickness of the specimens does not exceed 2 mm and the rise in temperature is kept below 2°C. The flash method proposed by Parker has been used, considering that the determination of the thermal diffusivity of materials by means of pulse methods is strongly dependent upon the specimen thickness and energy pulse. Due to the physical and geometrical characteristics of the samples employed, corrections for the effects of thermal losses caused by finite pulse time, radiant energy penetration, flash lamp efficiency, etc., do not need to be considered. The results obtained show very good agreement with those reported by Lurikis et al. [Lurikis W, Desmet C, Glorieux C, Thoen J. J Mater Res 1993; 8(12): 3106] using the Mirage method and those of Navarrete (Navarrete M. Ph.D. thesis, Faculty of Sciences, National University of Mexico, DF Mexico, 1998) for a classical non-steady state method. (Auth)
Short take: Scratching the surface?

This article focuses on Keronite surface treatment - a variation of spark anodising - originally developed in Russia for aerospace, military and industrial applications. The treatment enhances the surface properties of aluminium, magnesium, titanium and their alloys. Keronite is applied by an electro-chemical process in which a surface layer is formed by plasma electrolytic oxidation of the substrate metal. The ceramic layer formed is composed primarily of complex oxides of the main components in the substrate alloy. The Keronite coating consists of three zones: the technological layer (30-60 microns); the intermediate functional layer (up to 200 microns), and a thin transitional layer (up to 5 microns) between the base metal and the ceramic upper layers. The article gives a figure showing these layers, and a figure describing the microhardness of each of these layers.

The properties of Keronite coated alloys include: high microhardness values (up to 2000HV); high wear resistance; strong adhesion of the coating to the base metal; high heat resistance (short exposures of up to 2000C); high corrosion resistance; low friction coefficient (less than 0.1 when polished and lubricated), and it can be impregnated or treated with other finishes. A table is provided showing the microhardness of Keronite on different metal and alloy surfaces. Further figures are provided showing wear resistance of Keronite on various alloys, and the surface hardness of Keronite compared with several other metals.

Keronite treatment may enable magnesium to be used more in motor sport applications, such as in oil pump internals, pistons and cylinder liners. Other engine-related components which may benefit from Keronite treatment include cylinder blocks, sliding bearings, exhaust manifolds and valve trains, while wheel system components such as axles and spindles could be made from light alloys instead of steel if given a surface treatment. (RS)

Dymanic damage and fracture mechanism of three-dimensional braided carbon fiber/epoxy resin composites

Three-dimensional braided carbon fiber/epoxy resin composites are significant structural materials in the fields of astronauts and aeronautics. The effect of the process and test parameters on the mechanical properties was studied in this paper. Optical microscope and field emission gun scanning electron microscope (SEM) were used to analyse the macro- and micro-fracture morphology. The fracture morphology of the three-dimensional braided carbon fiber/epoxy resin composites was varied under different loading rates. The results indicate that the mechanical properties can be significantly affected by the parameters of braiding. By decreasing the braided angle the elastic modulo E and ultimate tensile strength showed an obvious increase. The fracture process depends on stress transfer behaviour. The fracture characteristic was brittle, which originated from plastic constraint at the fiber. Fiber fracture was caused by a defect on the surface of the carbon fiber in low loading rate. As the explosive impact test was carried out in a special attachment, superior energy absorption capability and damage tolerance were found. Due to high bursting pressure a surface ablation region was formed and a notch was observed in the region. The fibers in the surface ablation region were sheared off and pulled out. The fracture of fiber was scarcely related to any fiber defects in this region. There was a damage region under the ablation layer. Fracture morphology revealed that the epoxy area between fibers showed crack growth traces, which looked like a river pattern. The river pattern is the sign of brittle fracture and the direction of the river pattern is toward the direction of crack spreading. The fracture process showed that damage formation were fiber sheared off and epoxy flaked off under the ablation region. The propagation path of
the macro-crack is mainly in the braided sheaf and along the sheaf interface under the ablation region. (Auth)

Materials and Design Vol 22 No 1 01FEB2001, p 21 (5 p, 6 fig, 10 ref)
Index Terms: IMPACT/ EPOXY RESIN/ CARBON FIBRE
Doc No155270

'Hi-Per Blue', valve seal material from Industries ROL in Canada

Industries ROL has brought out an exclusive valve seal material which is an improved mixture of nitrile and cork known as 'Hi-Per Blue'. The material swells by about 30% on contact with the oil inside the valve, increasing the pressure at the piston and on the gasket, helping to seal off any leaks due to scratches caused by changing the gasket. Hi-Per Blue goes back to its original shape very quickly when compressed, and does not flatten like rubber when subjected to high oil temperatures. (CP)

L'Automobile Vol.60, No.4 01AUG2000, p40 (1 p)
Index Terms: INDUSTRIES ROL/ MATERIALS/ VALVES
Doc No154968
(In FRENCH)

Hydrogen storage in silicon - a potential fuel replacement in fuel cell vehicles

Silicon represents an emission-free and cost-effective fuel alternative for motor vehicles. This process, which produces hydrogen from water and silicon, has recently been developed and realised at the Institute of Machine Design and Automotive Engineering at the University of Karlsruhe. The specific energy density of silicon is comparable to methanol and liquid hydrogen. But in contrast to methanol there are no CO2 emissions and no safety issues. Silicon is non-toxic and can be stored for unlimited periods and transported under standard conditions. (Auth)

ATZ 7-8/2000 01JUL2000, p 42 (6 p)
Index Terms: SILICON/ EMISSIONS/ FUEL/ HYDROGEN/ UNIVERSITY OF KARLSRUHE
Doc No155262
(In GERMAN and ENGLISH)

Phase structure control of epoxy/polysulfone blends - effects of molecular weight of epoxy resins

Phase separation during the curing reaction in blends of diglycidyl ether of bisphenol A (E56, E51, E42, E39, E31, respectively), polysulfone (PSF) and diaminodiphenylsulfone (DDS, curing agent) was studied. Effects of epoxy resins with different molecular weight on phase structure of the blends were investigated. The relation between the degree of conversion and reaction time revealed that vitrification and gelation greatly affected the formation of phase structure in the low molecular weight epoxy systems. When Tg of the epoxy-rich phase went up to the reaction temperature, both reaction and phase separation were suppressed. While in the high molecular weight epoxy systems, the viscosity increasing of epoxy resins played an important role. Although the degree of conversion of the epoxy-rich phase did not reach the gel point after 24-h precure, phase separation was suppressed due to the high viscosity of the systems. SEM results showed that the desired phase structure could be achieved by using epoxy resins of different molecular weight. (Auth)

Materials and Design Vol 22 No 1 01FEB2001, p 7 (3 p, 5 fig, 7 ref)
Index Terms: MATERIALS/ EPOXY RESIN VISCOSITY
Doc No155267
RECYCLING/END-OF-LIFE VEHICLES

Dodge the scrapyard

DaimlerChrysler's CARE project (Concept for Advanced Recycling and Environment) is currently showing two Dodge Stratus prototypes that contain 40 per cent recycled materials developed by Lear and Johnson Controls. DaimlerChrysler are aiming to see some of its cars contain 30 per cent recycled plastic by weight and be manufactured from 95 per cent recoverable materials by 2005. (HL)
Production

Computer tomography in component development at Volkswagen

Ever shorter product development times, the use of new manufacturing processes and the constant increases in prototype quality requirements are turning computer tomography into a testing and measuring tool that will establish itself in the automotive industry in the near future. Using various cylinder heads, turbochargers and inlet manifolds as examples, this article illustrates the potential that computer tomography technology holds for the automobile industry. (Auth)

Laser for automotive manufacturing

Today, the laser is an indispensable tool in almost any area of automotive manufacturing. Laser material processing has soon become an established key technique in production technologies. With a diversified product range and the competence of the leader in lasertechnology, the worldwide operating Trumpf Group is a close partner for automotive manufacturers and their suppliers. The latest car model project in production stage involves body-in-white laserwelding of the new innovative high volume Audi A2 aluminum space frame. (Auth)

Parallel plate hydroforming

Parallel plate hydroforming opens up new opportunities for hydroforming automotive structural components. Compared with tube hydroforming, parallel plate hydroforming offers several distinct advantages, especially with regard to component design. On the other hand typical process limits and resultant design guidelines must be taken into account. The following article discusses some of the advantages provided by parallel plate hydroforming and details the process limits. (Auth)

Precision and endurance - robots weld Mercedes CLK front end

High repeatability and continuous availability are what automotive supplier Lapple requires most of all from its welding robots. Lapple's fast-paced environment - with three shift operation and "just in time" contracts demands precise welding processes and extraordinary staying power. Operational readiness is further enhanced by the PC based KUKA robot controller, which provides significant time savings when making program changes or correcting malfunctions. (Auth)
Seiatsu air flow press moulding process and production monitoring

For products made of cast iron with flake or modular graphite, the reliability of certain casting tests and the reproducibility of the measuring results was an issue even before certification according to DIN ISO 9001. This article examines to what extent characteristic values, standards and test results can be transferred from one foundry to another. Due to the high reproducibility and mould quality of the castings, the Seiatsu Air Flow Press Moulding Process, which the HeinrichWagner Sinto Maschinenfabrik GmbH, Bad Laasphe, offers with its moulding machines, is best suited for this study. Using this process, the moulding parameters for green sand moulds can be seen as being virtually constant. (Auth)

The TG-A trucknology generation from MAN commercial vehicles

The extremely successful F2000 Evolution model series in all its variations should be replaced by the TG-A within two years. TG-A is the most ambitious project that MAN has ever tackled, involving development and production costs of over 1 billion DM. The Trucknology Generation gives an outlook to the future of commercial vehicles which will be dominated by the use of modern electronics. (Auth)

The virtual factory of Adam Opel AG

In the face of evolutionary product development, planning an automotive plant that will satisfy increasing productivity and efficiency demands for a number of years is a major challenge. Influencing factors of opposing polarity apply as a result of official legislation, global market structures and last but not least the general speed-up in the already indispensable area of computer technology. Manufacturers are therefore obliged to make their production processes continually faster, more flexible and more cost effective. The digital imaging and simulation of projected production facilities, referred as the “virtual factory” for short, has considerable potential in this respect. (Auth)

Well prepared for the future - steel today, aluminium tomorrow

Schuler Automation GmbH & Co. KG is underlining its claim to be the world’s leading system supplier of automated stamping plants: for the first time, the company is supplying a complete blanking line to Shanghai Volkswagen in China. The system, which is equipped with a mechanical 630-tonne press, meets the high demands for the manufacture of automobile body parts with all its components. With aluminum constantly gaining significance in the automobile industry, all systems components have been prepared to handle aluminum as well as steel coils in future. Therefore the blanking line for Shanghai VW is fitted with a washing machine which can be raised by a lifting table, as well as fully automatic cassette change in the straightener. The stacking system has been fitted with devices for the assembly of additional vacuum belts to transport and release aluminum blanks. The option of working steel and aluminum on one single plant is one of the outstanding features offered by Schuler Automation, giving their clients a high degree of flexibility. (Auth)
Research

Anechoic chamber and attached equipment
An anechoic chamber is one of important equipment for the noise reduction work. This paper presents the characteristic of the anechoic chamber and several usages in automotive corporations, and describes the merit of using it. Finally this paper shows a measured example of the gear box noise using the near field holography method in the anechoic chamber. (Auth)

Journal of Society of Automotive Engineers of Japan Vol 54 No 6 01J UN2000, p 32 (4 p, 7 fig, 7 ref)
Index Terms: ANECHOIC/ NOISE/ CHAMBER/ GEARBOX/ HOLOGRAPHY
Doc No155491
(In JAPANESE)

Crash test laboratory for truck
Nissan Diesel has established a new crash test laboratory in April, 1998. This paper describes specifications and performance of the laboratory, and introduces development of occupant protect equipment of truck. This laboratory must realize timely and accurate development of safety truck. (Auth)

Journal of Society of Automotive Engineers of Japan Vol 54 No 6 01J UN2000, p 18 (3 p, 6 fig)
Index Terms: NISSAN DIESEL/ CRASH TEST/ LABORATORY/ OCCUPANT PROTECTION/ TRUCK
Doc No155488
(In JAPANESE)

Ford Research Centre Aachen
The Ford Forschungszentrum Aachen (FFA, Ford Research Centre Aachen) which was founded in 1994, supports Ford's objective of becoming the leader manufacturer of automobiles which set standards with respect to safety and the environment. The areas of research range from atmospheric science through the development of diesel engines to pedestrian protection. (Auth)

ATZ 7-8/2000 01J UL2000, p 22 (3 p)
Index Terms: FORD/ SAFETY/ ENVIRONMENT/ RESEARCH
Doc No155174
(In GERMAN and ENGLISH)

Introduction to a proving centre in North America
Nestled at the foot of the Sierra Nevada Mountains, Honda Proving Centre of California (HPCC) is designed for field adaptability testings. It has 12km oval track, 7.2km winding road and other tracks such as gravel road and off-road motorcycle tracks. (Auth)

Journal of Society of Automotive Engineers of Japan Vol 54 No 6 01J UN2000, p 13 (5 p, 4 fig)
Index Terms: HONDA R&D OF NORTH AMERICA/ PROVING GROUNDS/ TEST FACILITIES/ TRACK/ ROAD
Doc No155479
(In JAPANESE)

An investigation into factors associated with hard shoulder stoppages
In the summer of 1999 the Highways Agency instigated a questionnaire survey of drivers stopped on the hard shoulders of motorways. This had the aim of determining the factors contributing to motorway accidents, with respect to those relating to weather, time of day and visibility, road characteristics and driver and vehicle related factors. Data were collected between June and September with the co-operation of police forces throughout the UK and the exercise was co-ordinated by the Cheshire Constabulary. TRL analysed the data from the study and reported the findings. (Auth)

Transport Research Laboratory TRL Report 465 09SEP2000, p 1 (12 p, 20 fig, 1 ref)
Index Terms: HARD SHOULDER/ MOTORWAY/ ACCIDENTS/ DATA
Doc No154565
(Not available for supply)
Low pressure low temperature testing chamber

There are testing chambers to reproduce various environments which motor vehicles encounter. In the said testing chambers, tests are carried out so that test vehicles may drive in the same conditions as those in the natural environment. This paper outlines the low pressure/low temperature testing chamber, which is one of these testing chambers.

(Multilingual Abstracts) Journal of Society of Automotive Engineers of Japan Vol 54 No 6 01J UN2000, p 45 (4 p, 6 fig, 2 ref)
Index Terms: TEMPERATURE/ TEST FACILITIES/ CHAMBER/ ENVIRONMENT/ WEATHER CONDITIONS
Doc No155494
(In JAPANESE)

Low temperature laboratory with a snow machine

Powder snow in the natural world has a very bad influence on a vehicle. So we have studied how to make powder snow and duplicate actual conditions (blizzard, etc) in the testing chamber. It was difficult, but eventually we built a test machine in the chamber. In this thesis, I explain how we accomplished our mission.

(Multilingual Abstracts) Journal of Society of Automotive Engineers of Japan Vol 54 No 6 01J UN2000, p 41 (4 p, 7 fig, 1 ref)
Index Terms: SNOW/ WEATHER CONDITIONS/ TEST CHAMBER
Doc No155493
(In JAPANESE)

Mega web

The facilities of a theme park for motor vehicles "MEGA WEB" was opened at the New Tokyo Sub-center on the waterfront in March 1999. In MEGA WEB, a new style of marketing research has been carried out experimentally making good use of the amusement facilities/equipment: obtaining information from visitor's trial records of using attractions was adopted and collecting information from experimental results made inside the facilities was performed according to the original system of MEGA WEB.

(Multilingual Abstracts) Journal of Society of Automotive Engineers of Japan Vol 54 No 6 01J UN2000, p 78 (4 p, 7 fig)
Index Terms: MEGA WEB/ MARKETING/ RESEARCH/ INFORMATION
Doc No155501
(In JAPANESE)

A proving ground for heavy duty vehicle

Nissan Diesel Motor Co opened Motegi proving ground in 1988 as an experimental development base in Motegi Machi, Tochigi prefecture. Many kinds of test roads were constructed for about ten years while economic conditions have been changed rapidly. We present Motegi proving ground explain the development of ESUS CABIN for a tractor.

(Multilingual Abstracts) Journal of Society of Automotive Engineers of Japan Vol 54 No 6 01J UN2000, p 9 (4 p, 8 fig)
Index Terms: NISSAN DIESEL/ MOTEGI PROVING GROUNDS/ TEST FACILITIES/ TRACTOR
Doc No155478
(In JAPANESE)
Hydraulic bulging tests - the coming of age

Bulging through an aperture by lateral fluid pressure stretches the sheet metal without the complication of wrapping around a forming tool. The bulge curvature enables the stress at the centre of the bulge to be calculated, thus offering the best means of examining plastic behaviour in conditions resembling press forming. The article discusses the sophistication of this as a test method, together with the instrumentation requirement, showing the bulging chamber built at Wollongong University. The article points out the interest of the pole of the bulge where the strain is biaxial, rather than uniaxial as in conventional strain tests. Figures showing the stress-strain relationship for a low-carbon steel and the two-stage hardening of low-carbon steel are provided. The servo-hydraulic apparatus and computing requirements of the testing method are complex, but specimen preparation is very simple. (RS)

Mobile measurement of topological road data for dynamic rig testing and computer simulation

Reduced development times, customer-oriented quality improvements and low-cost engineering and manufacturing technologies for motor vehicles require more and more advanced methods of rig testing. Besides vehicle dynamics, the reliability of the powertrain over the entire vehicle lifetime has become a major quality characteristic of modern motor vehicles. Evaluating the reliability of the powertrain by rig testing requires high-precision topological data of the test tracks to be simulated. Together with "Gesellschaft fur Industrieforschung mbH (GIF)", Ford Motor Company has therefore developed a measuring trailer which is able to record topological road data relevant for rig testing within an accuracy of approximately 1 cm. In this way, Ford is able to simulate realistic road curve radii and longitudinal and lateral road surface inclinations on the test rig. (Auth)
Short, sharp, shock - testing materials at high strain rates

The article points out that many engineering situations find materials under high strains subjected in very short time periods. Furthermore, at high strain rates many material properties change so that quasi-static stress-strain data is unreliable for design predictions. The article then surveys the available equipment for achieving high strain rate data, from Charpy impact pendulum machines, drop weight impact testing machines, Hopkinson bar and gas guns - the latter capable of strain rates of up to 100,000/sec with energies of up to 600,000J. The automotive industry typically uses the hydraulic catapult rig, accelerating components fixed to a sledge into obstacles to simulate crash conditions.

The article then considers in detail Instron’s servohydraulic high strain rate testing machine the VHS8800, capable of generating strain rates in the region 1-1000/sec with 'impact' energies of up to 10,000J. It can also be used for static and quasi-static tests and may be configured for high speed tension, bend and impact tests between -150C and 600C. The article reports Volvo’s purchase of an Instron machine for its strength of materials R&D laboratory, which it will use to generate input data for crash simulation calculations. The article also considers software requirements of the testing equipment and methods of reducing system resonance. Three figures showing Instron’s installations are included, with graphs showing the effect of the software during the critical loading period. (RS)

Simulation on the dynamic engine test bed

The development of Continuously Variable Transmissions (CVT) is currently a major focus in the automotive industry. Following the actual development trends the market now also demands test beds which can simulate the dynamic behaviour of CVT gearboxes. By combining the test bed control and simulation unit EMCON 1 ISAC with the open simulation software MATLAB 1 SIMULINK AVL List and the Technical University of Graz found a new solution. (Auth)
Top packaging design is meat and drink to award winners

This article surveys the winners of the Institute of Packaging Starpack Awards 2000. Many supermarket items are featured, including methods of packaging fresh food products.

A gold award winner was SCA Packaging Heavy Duty Division for its new method of packing car bonnets for Unipart DCM. The pack is designed to allow the safe handling of a range of Jaguar car bonnets, and it is estimated that it will save £80,000 per year of damage. Photographs of this and the other award winners are included in the article. (RS)
Automobile Abstracts  October 2000 (31/10/2000)

Road Tests

Alfa Romeo 156 2.4 JTD, Mercedes C220 CDI (Comparative Test)
Auto Motor Und Sport  No 21  04OCT2000,  p 72 (5 p, 15 fig)
Index Terms: ALFA ROMEO/ MERCEDES/ ROAD TEST
Doc No155113
(In GERMAN)

BMW 520i, Mercedes E200 K Elegance (Comparative Test)
Auto Motor Und Sport  No 20  20SEP2000,  p 44 (6 p, 23 fig)
Index Terms: BMW/ MERCEDES/ ROAD TEST
Doc No155106
(In GERMAN)

Citroen Xsara Picasso HDI SX, Nissan Almera Tino 2.2 DI Comfort, Opel Zafira 2.0 DTI 16V Comfort (Comparative Test)
Auto Motor Und Sport  No 20  20OCT2000,  p 80 (7 p, 29 fig)
Index Terms: CITROEN/ NISSAN/ OPEL/ ROAD TEST
Doc No155109
(In GERMAN)

Double delight (Man TG-A)
Index Terms: MAN
Doc No155388

Fiat Punto 1.2 16V ELX, Opel Corsa 1.2 16V Comfort, Renault Clio 1.4 RT, VW Polo 1.4 16V Trendline (Comparative Test)
Auto Motor Und Sport  No 21  04OCT2000,  p 40 (8 p, 30 fig)
Index Terms: FIAT/ OPEL/ RENAULT/ VW/ ROAD TEST
Doc No155112
(In GERMAN)

Ford Fiesta 1.4 Ghia 5dr, Skoda Fabia 1.4 16v 5dr, Toyota Yaris 1.3 GLS 5dr, Vauxhall Corsa 1.4 Comfort 3dr (Comparative Test)
Car  November 2000  01NOV2000,  p 58 (12 p, 34 fig)
Index Terms: FORD/ SKODA/ TOYOTA/ VAUXHALL/ ROAD TEST
Doc No155404

Ford Focus 1.8 DI, VW Golf 1.9 TDI (Comparative Test)
Auto Motor Und Sport  No 21  04OCT2000,  p 86 (4 p, 8 fig)
Index Terms: FORD/ VW/ ROAD TEST
Doc No155114
(In GERMAN)

Land Rover Discovery Td5 GS, Mercedes-Benz ML270CDi, Mitsubishi Shogun 3.2 DI-D Classic 5dr (Comparative Test)
Car  November 2000  01NOV2000,  p 170 (6 p, 20 fig)
Index Terms: LAND ROVER/ MERCEDES-BENZ/ MITSUBISHI/ ROAD TEST
Doc No155406

Lotus Elise, Vauxhall VX220 (Comparative Test)
Car  November 2000  01NOV2000,  p 158 (4 p, 12 fig)
Index Terms: LOTUS/ VAUXHALL/ ROAD TEST
Doc No155405

Mercedes-Benz C320
Road & Track  October 2000  01OCT2000,  p 56 (5 p, 9 fig)
Index Terms: MERCEDES-BENZ/ ROAD TEST
Doc No154938
**Mercedes C-Class**

*Autocar* No 39  27SEP2000,  p 68 (4 p, 8 fig)
Index Terms: MERCEDES
Doc No155387

**Opel Agila 1.0 12V Elegance, Hyundai Atos GLS (Comparative Test)**

*Auto Motor Und Sport* No 20  20SEP2000,  p 60 (4 p, 12 fig)
Index Terms: OPEL/ HYUNDAI/ ROAD TEST
Doc No155107
(In GERMAN)

**Scania R164**

*Commercial Motor* 5 - 11 October 2000  05OCT2000,  p 28 (6 p, 11 fig)
Index Terms: SCANIA/ ROAD TEST
Doc No154934

**Toyota RAV4**

*Auto Motor Und Sport* No 20  20SEP2000,  p 64 (5 p, 12 fig)
Index Terms: TOYOTA/ ROAD TEST
Doc No155108
(In GERMAN)

**Vauxhall Corsa**

*Autocar* No 38  20SEP2000,  p 60 (4 p, 8 fig)
Index Terms: VAUXHALL/ ROAD TEST
Doc No154944

**Volvo S60**

*Autocar* No 42  18OCT2000,  p 74 (6 p, 13 fig)
Index Terms: VOLVO
Doc No155103
<table>
<thead>
<tr>
<th>3D</th>
<th>21, 60, 64</th>
<th>BOSCH, 64, 67, 71, 74</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABRASION</td>
<td>85</td>
<td>BOUNDARY ELEMENT, 52</td>
</tr>
<tr>
<td>ABS</td>
<td>21, 33</td>
<td>BOUNDARY ELEMENT METHOD, 52</td>
</tr>
<tr>
<td>AC</td>
<td>61</td>
<td>BOYSEN, 70</td>
</tr>
<tr>
<td>ACC</td>
<td>50</td>
<td>BP, 44</td>
</tr>
<tr>
<td>ACCIDENT</td>
<td>1, 15, 16, 17, 18, 19, 20, 47, 48, 50, 91</td>
<td>BRAKE, 45, 46, 55</td>
</tr>
<tr>
<td>ACCIDENT SIMULATION</td>
<td>1, 19</td>
<td>BRAKING, 1, 2, 28, 46, 55, 56</td>
</tr>
<tr>
<td>ACOUSTICS</td>
<td>45</td>
<td>BRAKING EQUIPMENT, 2, 55</td>
</tr>
<tr>
<td>ACOUSTICS</td>
<td>51</td>
<td>BRAKING PERFORMANCE, 1, 46</td>
</tr>
<tr>
<td>ADAPTIVE CRUISE CONTROL</td>
<td>50</td>
<td>BUS, 34, 64</td>
</tr>
<tr>
<td>ADAPTIVE SYSTEMS</td>
<td>46</td>
<td>BUSES, 34, 64</td>
</tr>
<tr>
<td>ADDITIVES</td>
<td>81</td>
<td>CAD, 78</td>
</tr>
<tr>
<td>AERODYNAMIC</td>
<td>45, 46</td>
<td>CADILLAC, 37</td>
</tr>
<tr>
<td>AERODYNAMICS</td>
<td>1, 45</td>
<td>CAE, 60, 70</td>
</tr>
<tr>
<td>ACCIDENT, 1, 15, 16, 17, 18, 19, 20, 47, 48, 50, 91</td>
<td>CALIBRATION, 60, 61, 68</td>
<td></td>
</tr>
<tr>
<td>ACCIDENT SIMULATION</td>
<td>1, 19</td>
<td>CAMS, 2, 68</td>
</tr>
<tr>
<td>ACS</td>
<td>61</td>
<td>CAN, 73</td>
</tr>
<tr>
<td>ACS</td>
<td>61</td>
<td>CARBON, 58, 85, 87</td>
</tr>
<tr>
<td>ACS</td>
<td>61</td>
<td>CARBON BLACK, 58</td>
</tr>
<tr>
<td>ACS</td>
<td>61</td>
<td>CARBON FIBRE, 87</td>
</tr>
<tr>
<td>ACS</td>
<td>61</td>
<td>CARS, 19, 71</td>
</tr>
<tr>
<td>ACS</td>
<td>61</td>
<td>CASTING, 69, 90</td>
</tr>
<tr>
<td>ACS</td>
<td>61</td>
<td>CATALYSTS, 69</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>CAVITATION, 66</td>
</tr>
<tr>
<td>AIR CONDITIONING SYSTEMS</td>
<td>51</td>
<td>CERAMICS, 78</td>
</tr>
<tr>
<td>AIRBAGS</td>
<td>1, 36, 49</td>
<td>CFD, 64, 68</td>
</tr>
<tr>
<td>AIRBAGS</td>
<td>1, 36, 49</td>
<td>CHARGING, 14, 15</td>
</tr>
<tr>
<td>AIR BAG</td>
<td>49</td>
<td>CHASSIS, 23, 28, 45, 57, 79</td>
</tr>
<tr>
<td>AIR BAGS</td>
<td>49</td>
<td>CHINA, 79</td>
</tr>
<tr>
<td>AIR Conditioning</td>
<td>51</td>
<td>CHRYSLER, 25, 62, 74</td>
</tr>
<tr>
<td>AIR CONDITIONING SYSTEMS</td>
<td>51</td>
<td>CITROEN, 19, 44, 96</td>
</tr>
<tr>
<td>AIR Conditioning</td>
<td>51</td>
<td>CLEANING, 22</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COATINGS, 2, 85</td>
</tr>
<tr>
<td>AIR CONDITIONING SYSTEMS</td>
<td>51</td>
<td>COLD, 65</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COLD START, 65</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COLLISION, 59</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COLOUR, 47</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMBUSTION, 2, 60, 61, 63, 64, 65, 68</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMBUSTION CHAMBERS, 2, 68</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMBUSTION ENGINE, 64, 65</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMFORT, 51, 53, 54, 62</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMMERCIAL, 34, 44, 45, 90</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMMERCIAL VEHICLE, 34, 44, 90</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMMON RAIL, 67</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMMUNICATION, 47, 75</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMMUNICATION SYSTEMS, 47</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMPANY REVIEWS, 1, 13</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMPONENTS, 1, 49, 53, 60, 66, 67, 68, 69, 74, 79, 84, 90</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMPOSITE, 73</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMPOSITES, 74</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMPRESSOR, 74</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMPUTER, 82, 90</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMPUTER SYSTEMS, 82</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>COMPUTERS, 89</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>CONDENSERS, 51</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>CONDITIONS, 92</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>CONSTRUCTION, 23</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>CONSUMPTION, 24, 61, 62, 64, 67, 68, 82</td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td>CONTINENTAL, 56</td>
</tr>
<tr>
<td>AGE</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>AIR</td>
<td>49, 51, 53, 77</td>
<td></td>
</tr>
<tr>
<td>AIR BAG</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>AIR BAGS</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>AIR CONDITIONING</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>AIR CONDITIONING SYSTEMS</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>AIRBAGS</td>
<td>1, 36, 49</td>
<td></td>
</tr>
<tr>
<td>ALCOHOL</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>ALFA</td>
<td>26, 27, 96</td>
<td></td>
</tr>
<tr>
<td>ALFA ROMEO</td>
<td>26, 27, 96</td>
<td></td>
</tr>
<tr>
<td>ALGORITHM</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>ALLOY</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>ALLOYS</td>
<td>49, 78, 83</td>
<td></td>
</tr>
<tr>
<td>ALTERNATIVE</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>ALTERNATIVE FUEL</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>ALTERNATIVE FUELS</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>ALTERNATIVELY POWERED VEHICLES</td>
<td>1, 38, 43, 44</td>
<td></td>
</tr>
<tr>
<td>ALUMINIUM</td>
<td>23, 28, 32, 49, 63, 83, 89, 90</td>
<td></td>
</tr>
<tr>
<td>ALUMINIUM ALLOYS</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>ALUMINIUM STRUCTURES</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>ANALYSIS</td>
<td>20, 21, 45, 52, 54, 59, 70, 82</td>
<td></td>
</tr>
<tr>
<td>AUDI</td>
<td>26, 27, 35, 37, 41, 42, 53, 61, 72, 89</td>
<td></td>
</tr>
<tr>
<td>AUSTRALIA</td>
<td>16, 48, 65, 93</td>
<td></td>
</tr>
<tr>
<td>AUTOMATIC</td>
<td>32, 34, 55, 71, 72, 73</td>
<td></td>
</tr>
<tr>
<td>AUTOMATIC TRANSMISSIONS</td>
<td>32, 34, 71, 72, 73</td>
<td></td>
</tr>
<tr>
<td>AUTOMATION</td>
<td>72, 90</td>
<td></td>
</tr>
<tr>
<td>AUTOMOBILE</td>
<td>2, 12, 103</td>
<td></td>
</tr>
<tr>
<td>AUTOMOTIVE</td>
<td>64, 75</td>
<td></td>
</tr>
<tr>
<td>AUTOMOTIVE PRODUCTS</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>AVL</td>
<td>45, 60, 67, 94, 95</td>
<td></td>
</tr>
<tr>
<td>AVL LIST</td>
<td>60, 67</td>
<td></td>
</tr>
<tr>
<td>AWD</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>AXIAL</td>
<td>73, 74</td>
<td></td>
</tr>
<tr>
<td>AXLES</td>
<td>2, 57, 73</td>
<td></td>
</tr>
<tr>
<td>BASF</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>BATTERIES</td>
<td>71, 75</td>
<td></td>
</tr>
<tr>
<td>BEHAVIOUR</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>BEHR</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>BELT</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>BELTS</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>BENCH TEST</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>BENCHMARKING</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>BICYCLES</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>BODY</td>
<td>1, 20, 23, 49, 84, 89, 90</td>
<td></td>
</tr>
<tr>
<td>BODY COMPONENTS</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>BODY DESIGN</td>
<td>1, 23, 49</td>
<td></td>
</tr>
<tr>
<td><strong>Automobile Abstracts</strong></td>
<td><strong>October 2000 (31/10/2000)</strong></td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td>CONTINENTAL TEVES, 56</td>
<td>DYNAMICS, 20, 24, 25, 54, 58, 72, 95</td>
<td></td>
</tr>
<tr>
<td>CONTROL, 28, 55, 56, 65, 67, 72, 73, 75</td>
<td>ECONOMY, 18, 64</td>
<td></td>
</tr>
<tr>
<td>CONTROL SYSTEMS, 28, 56, 72</td>
<td>EGR, 61, 63</td>
<td></td>
</tr>
<tr>
<td>COOLANT, 77</td>
<td>ELDERLY, 17, 19</td>
<td></td>
</tr>
<tr>
<td>COOLANTS, 2, 77</td>
<td>ELDERLY DRIVERS, 17, 19</td>
<td></td>
</tr>
<tr>
<td>COOLING, 1, 51</td>
<td>ELECTRIC, 1, 22, 43, 71</td>
<td></td>
</tr>
<tr>
<td>COSTS, 18, 22</td>
<td>ELECTRIC MOTOR, 71</td>
<td></td>
</tr>
<tr>
<td>COUPLINGS, 60</td>
<td>ELECTRIC MOTORS, 71</td>
<td></td>
</tr>
<tr>
<td>CRANES, 31</td>
<td>ELECTRIC VEHICLE, 1, 22, 43, 71</td>
<td></td>
</tr>
<tr>
<td>CRANKCASE, 60</td>
<td>ELECTRICAL, 2, 74, 75</td>
<td></td>
</tr>
<tr>
<td>CRASH, 1, 19, 20, 21, 91</td>
<td>ELECTRICAL SYSTEMS, 2, 74, 75</td>
<td></td>
</tr>
<tr>
<td>CRASH RESEARCH, 20</td>
<td>ELECTRONIC, 55, 67</td>
<td></td>
</tr>
<tr>
<td>CRASH TEST, 1, 19, 20, 21, 91</td>
<td>ELECTRONIC CONTROL, 55, 67</td>
<td></td>
</tr>
<tr>
<td>CRASH TESTS, 1, 19, 20, 21</td>
<td>ELECTRONIC CONTROL UNITS, 67</td>
<td></td>
</tr>
<tr>
<td>CRASHWORTHINESS, 49</td>
<td>ELECTRONICS, 2, 75, 90</td>
<td></td>
</tr>
<tr>
<td>CRUISE, 50</td>
<td>EMC, 2, 75, 76</td>
<td></td>
</tr>
<tr>
<td>CRUISE CONTROL, 50</td>
<td>EMISION, 65</td>
<td></td>
</tr>
<tr>
<td>CRUSH, 73</td>
<td>EMISSION CONTROL, 65</td>
<td></td>
</tr>
<tr>
<td>CVT, 22, 44, 94</td>
<td>EMISSION CONTROL DEVICES, 65</td>
<td></td>
</tr>
<tr>
<td>CYCLE, 59, 82</td>
<td>EMISSIONS, 2, 22, 24, 38, 57, 61, 62, 63, 64, 67, 68, 82, 87</td>
<td></td>
</tr>
<tr>
<td>CYLINDER, 2, 61, 62, 63, 68</td>
<td>ENERGY, 20, 21, 64, 73, 74, 82, 85</td>
<td></td>
</tr>
<tr>
<td>CYLINDER ENGINE, 61, 62</td>
<td>ENERGY ABSORBING, 20, 73, 74</td>
<td></td>
</tr>
<tr>
<td>CYLINDER ENGINES, 61, 62</td>
<td>ENERGY ABSORPTION, 21</td>
<td></td>
</tr>
<tr>
<td>CYLINDER HEAD, 2, 68</td>
<td>ENERGY CONSUMPTION, 64, 82</td>
<td></td>
</tr>
<tr>
<td>CYLINDER HEADS, 2, 68</td>
<td>ENGINE, 2, 27, 28, 29, 33, 34, 35, 37, 39, 59, 60, 61, 62, 63, 65, 66, 67, 68, 69, 70, 77, 95</td>
<td></td>
</tr>
<tr>
<td>CYLINDERS, 67</td>
<td>ENGINE COMPONENTS, 2, 66, 67, 68, 69</td>
<td></td>
</tr>
<tr>
<td>DAEWOO, 19, 28</td>
<td>ENGINE DESIGN, 59, 60, 62</td>
<td></td>
</tr>
<tr>
<td>DAF, 13, 14</td>
<td>ENGINE DEVELOPMENT, 35</td>
<td></td>
</tr>
<tr>
<td>DAF TRUCKS, 13, 14</td>
<td>ENGINE PERFORMANCE, 27, 28, 29, 33, 34, 37, 39</td>
<td></td>
</tr>
<tr>
<td>DAF TRUCKS NV, 14</td>
<td>ENVIRONMENT, 22, 85, 91, 92</td>
<td></td>
</tr>
<tr>
<td>DAIHATSU, 19</td>
<td>EQUIPMENT, 55</td>
<td></td>
</tr>
<tr>
<td>DAIMLER, 25, 62, 74</td>
<td>ERF, 12</td>
<td></td>
</tr>
<tr>
<td>DAIMLERCHRYSLER, 34, 43, 44, 88</td>
<td>ERGONOMICS, 1, 46</td>
<td></td>
</tr>
<tr>
<td>DAMPERS, 53, 55</td>
<td>ESUS, 92</td>
<td></td>
</tr>
<tr>
<td>DAMPING, 54</td>
<td>ETC, 1, 14, 49, 75</td>
<td></td>
</tr>
<tr>
<td>DATA, 21, 23, 26, 60, 68, 74, 75, 91, 93</td>
<td>EU, 15, 69</td>
<td></td>
</tr>
<tr>
<td>DCM, 95</td>
<td>EURO 2, 67</td>
<td></td>
</tr>
<tr>
<td>DEFORMATION, 57</td>
<td>EURO 3, 66</td>
<td></td>
</tr>
<tr>
<td>DEGUSSA, 69</td>
<td>EURO NCAP, 20</td>
<td></td>
</tr>
<tr>
<td>DELPHI, 64, 75</td>
<td>EUROPEAN, 75</td>
<td></td>
</tr>
<tr>
<td>DELPHI AUTOMOTIVE, 64, 75</td>
<td>EV, 22</td>
<td></td>
</tr>
<tr>
<td>DELPHI AUTOMOTIVE SYSTEM, 64, 75</td>
<td>EVOBUS, 34</td>
<td></td>
</tr>
<tr>
<td>DELPHI AUTOMOTIVE SYSTEMS, 64, 75</td>
<td>EXHAUST, 2, 61, 62, 68, 69, 70</td>
<td></td>
</tr>
<tr>
<td>DENSO, 51</td>
<td>EXHAUST EMISSIONS, 68</td>
<td></td>
</tr>
<tr>
<td>DEVELOPMENT, 13, 23, 24, 26, 27, 28, 29, 30, 31, 33, 34, 35, 36, 37, 38, 39, 40, 41, 43, 45, 51, 53, 56, 61, 64, 68, 69, 70, 72, 74, 79, 90, 95</td>
<td>EXHAUST GAS, 61, 69</td>
<td></td>
</tr>
<tr>
<td>DIAGNOSTIC SYSTEM, 77</td>
<td>EXHAUST SYSTEM, 2, 62, 69, 70</td>
<td></td>
</tr>
<tr>
<td>DIESEL, 61, 63, 64, 66, 67, 77, 91, 92</td>
<td>EXHAUST SYSTEMS, 2, 62, 69, 70</td>
<td></td>
</tr>
<tr>
<td>DIESEL ENGINE, 61, 63, 64, 66, 67, 77</td>
<td>EXHAUSTS, 66</td>
<td></td>
</tr>
<tr>
<td>DIRECT INJECTION, 67</td>
<td>EXPERIMENT, 73</td>
<td></td>
</tr>
<tr>
<td>DISABILITIES, 46</td>
<td>EXPERIMENTS, 68, 74</td>
<td></td>
</tr>
<tr>
<td>DISPLAY, 76</td>
<td>EXTERIOR, 45</td>
<td></td>
</tr>
<tr>
<td>DOHC, 63</td>
<td>FATALITIES, 16</td>
<td></td>
</tr>
<tr>
<td>DOOR, 21</td>
<td>FATIGUE, 53, 56, 72, 83</td>
<td></td>
</tr>
<tr>
<td>DRIVELINES, 74</td>
<td>FAURECIA, 70</td>
<td></td>
</tr>
<tr>
<td>DRIVER, 2, 17, 75</td>
<td>FEE COLLECTION, 14, 15</td>
<td></td>
</tr>
<tr>
<td>DRIVER BEHAVIOUR, 17</td>
<td>FEM, 56</td>
<td></td>
</tr>
<tr>
<td>DRIVER INFORMATION SYSTEMS, 2, 75</td>
<td>FERROUS, 2, 82, 83</td>
<td></td>
</tr>
<tr>
<td>DRIVERS, 17, 19, 50</td>
<td>FERROUS METALS, 2, 82, 83</td>
<td></td>
</tr>
<tr>
<td>DRIVETRAIN, 24</td>
<td>FEV, 70</td>
<td></td>
</tr>
<tr>
<td>DRIVING, 17</td>
<td>FIA, 24</td>
<td></td>
</tr>
<tr>
<td>DTI, 96</td>
<td>FIAT, 19, 29, 39, 96</td>
<td></td>
</tr>
<tr>
<td>DUMMIES, 20</td>
<td>FIBRE OPTICS, 2, 75</td>
<td></td>
</tr>
<tr>
<td>DUNLOP, 59</td>
<td>FIBRE REINFORCED PLASTICS, 84</td>
<td></td>
</tr>
<tr>
<td>DYNAMIC, 56</td>
<td>FIBRES, 57, 84</td>
<td></td>
</tr>
</tbody>
</table>
Automobile Abstracts

FIELD OF VISION, 19
FILTRERS, 2, 66
FILTRATION SYSTEMS, 69
FINITE ELEMENT, 20, 21, 49, 52, 56
FINITE ELEMENT METHOD, 21, 49, 52, 56
FINITE ELEMENT MODEL, 20
FINITE ELEMENT MODELS, 20
FINLAND, 13
FIRE, 68
FIRESTONE, 58
FISITA, 22
FITTINGS, 51
FLOW, 61, 68, 74, 83
FLOWMETERS, 67
FLYWHEELS, 54
FODEN, 13, 34
FORD, 19, 30, 32, 33, 35, 43, 64, 73, 91, 93, 96
FORD MOTOR, 93
FORMULA 1, 23, 24
FOUR WHEEL DRIVE, 55, 56, 74
FRACTURE, 21, 78
FRAMES, 89
FRAMEWORK, 75
FRICTION, 46, 57, 58
FUEL, 2, 24, 43, 44, 61, 62, 63, 64, 65, 66, 67, 68, 69, 71, 87
FUEL CELL, 43, 44, 71
FUEL CONSUMPTION, 24, 61, 62, 63, 67, 68
FUEL ECONOMY, 64
FUEL INJECTION, 63, 66, 67, 69
FUEL SYSTEMS, 2, 66
FUELS, 22
GAS, 61, 64, 69, 83
GASOLINE, 67
GASOLINE DIRECT INJECTION, 67
GEAR, 2, 68, 72
GEARBOX, 91, 95
GERMAN, 23, 24, 25, 28, 30, 34, 38, 45, 49, 51, 53, 54,
  55, 56, 57, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70,
  72, 74, 75, 77, 84, 87, 89, 90, 91, 93, 95, 96, 97
GLASS, 73
GM, 37, 64
GOODYEAR, 57
GPS, 15
GREECE, 50
HANDLING, 35, 54
HEADLAMPS, 75
HEAT, 60, 64, 80
HEAT TRANSFER, 60, 64
HEAT TREATMENT, 80
HEATING, 1, 51
HEV, 22, 43
HIGH SPEED TRAINS, 46
HOLOGRAPHY, 91
HONDA, 28, 31, 38, 41, 43, 44, 91
HSDI, 67
HVAC, 1, 51
HYBRID, 43, 44, 71, 74
HYBRID VEHICLES, 43, 44, 71
HYDRAULIC, 77
HYDRAULICS, 72, 94
HYDROFORMING, 89
HYDROGEN, 71, 87
HYDROPLAING, 56
HYUNDAI, 37, 38, 39, 97
IGNITION, 2, 61, 62, 63, 67, 68, 69
IGNITION SYSTEMS, 2, 61, 67
IMPACT, 18, 21, 59, 80, 81, 87
IMPREZA, 31
INDUSTRY, 12
INFORMATION, 75, 92
INFORMATION SYSTEM, 75
INFORMATION SYSTEMS, 75
INJECTION, 22, 63, 66, 67, 68, 69
INJECTION Moulding, 69
INJURIES, 16, 18
INJURY, 20
INTELLIGENT, 15
INTELLIGENT TRANSPORTATION SYSTEMS, 15
INTERIOR, 1, 45, 51
INTERIOR FITTINGS, 1, 51
INTERIOR NOISE, 45
INTERIORS, 84
INTERNAL COMBUSTION ENGINE, 64
ISO, 45, 90
ITS, 4, 15, 75, 76
IVECO, 66, 73
IVECO FORD, 73
IVECO FORD TRUCK, 73
JAGUAR, 32, 36, 37, 49, 95
JAPANESE, 12, 45, 46, 54, 60, 72, 75, 76, 91, 92
JOINTS, 83
JUST IN TIME, 89
KIA, 28
KONI, 53
KOREA, 22
KUKA, 89
LAMINATES, 85
LAMPS, 75
LAND ROVER, 30, 32, 96
LASERS, 89
LATERAL, 20
LAW, 50
LEAN, 22
LEAN BURN, 22
LEAR, 84
LEAR CORP, 84
LED, 5
LEXUS, 30, 32
LIFE CYCLE, 82
LIFECYCLE, 81
LIFECYCLE ASSESSMENT, 81
LIGHTING, 2, 75
LINDE, 55
LOAD, 85
LOADING, 21, 74
LOADS, 56
LOW EMISSION, 68
LOW EMISSIONS, 68
LPG, 22
LUBRICATION, 2, 69
LUBRICATION SYSTEMS, 2, 69
LUK, 71
MAN, 33, 62, 70, 85
MANAGEMENT, 55
MANN AND HUMMEL, 69
MANUFACTURING, 89, 90
MARKET, 39, 42
MARKETING, 92
<table>
<thead>
<tr>
<th>Automobile Abstracts</th>
<th>October 2000 (31/10/2000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIALS, 2, 22, 46, 49, 74, 76, 78, 79, 80, 81, 82, 84, 87</td>
<td>PRODUCT DEVELOPMENT, 90</td>
</tr>
<tr>
<td>MATSUSHITA, 75</td>
<td>PRODUCTS, 75, 81, 82</td>
</tr>
<tr>
<td>MAZDA, 27, 31</td>
<td>PROTECTION, 91</td>
</tr>
<tr>
<td>MCC SMART, 19</td>
<td>PROTON, 25, 34, 43</td>
</tr>
<tr>
<td>MEASUREMENT, 45, 61, 67, 85</td>
<td>PROTOTYPES, 89</td>
</tr>
<tr>
<td>MECHANICS, 21, 51, 52, 72</td>
<td>PROVING GROUNDS, 91, 92</td>
</tr>
<tr>
<td>MERCEDES, 13, 25, 34, 40, 42, 54, 61, 62, 73, 89, 96, 97</td>
<td>PUMPS, 66</td>
</tr>
<tr>
<td>METALS, 69, 82, 83</td>
<td>QUALITY, 35</td>
</tr>
<tr>
<td>METERS, 67</td>
<td>RADIATORS, 51</td>
</tr>
<tr>
<td>METHANOL, 44</td>
<td>RAIL, 67</td>
</tr>
<tr>
<td>MICHELIN, 57</td>
<td>RECYCLING, 79, 85, 88</td>
</tr>
<tr>
<td>MICROWAVES, 65</td>
<td>REINFORCED PLASTICS, 84</td>
</tr>
<tr>
<td>MIRA, 1, 3, 103</td>
<td>RENAULT VI, 13</td>
</tr>
<tr>
<td>MITSUBISHI, 96</td>
<td>RESEARCH, 12, 20, 68, 79, 91, 92</td>
</tr>
<tr>
<td>MODEL, 20, 21, 46, 53, 57, 58, 64, 66, 67, 85</td>
<td>RESEARCH AND DEVELOPMENT, 79</td>
</tr>
<tr>
<td>MODELLING, 21, 72, 81</td>
<td>RESTRAINT, 49</td>
</tr>
<tr>
<td>MOTION, 59</td>
<td>RESTRAINT SYSTEM, 49</td>
</tr>
<tr>
<td>MOTOR INDUSTRY, 1, 12</td>
<td>RESTRAINTS, 1, 49</td>
</tr>
<tr>
<td>MOTOROLA, 50</td>
<td>RIDE, 53</td>
</tr>
<tr>
<td>MOTORS, 71</td>
<td>RIDE COMFORT, 53</td>
</tr>
<tr>
<td>MOTORSPORTS, 37</td>
<td>RIG, 93</td>
</tr>
<tr>
<td>MOULDING, 69, 90</td>
<td>RISK, 19</td>
</tr>
<tr>
<td>MOULDING TECHNOLOGY, 90</td>
<td>ROAD, 14, 15, 45, 57, 91, 93, 96, 97</td>
</tr>
<tr>
<td>MOUNTS, 53</td>
<td>ROAD CHARGING, 14, 15</td>
</tr>
<tr>
<td>MPV, 26, 42, 43</td>
<td>ROAD NOISE, 45</td>
</tr>
<tr>
<td>MW, 37, 55</td>
<td>ROAD PRICING, 14</td>
</tr>
<tr>
<td>NATURAL FIBRES, 84</td>
<td>ROBERT BOSCH, 67, 71</td>
</tr>
<tr>
<td>NATURAL GAS, 64</td>
<td>ROBOT, 89</td>
</tr>
<tr>
<td>NCAP, 19, 20, 35</td>
<td>ROLLING, 45</td>
</tr>
<tr>
<td>NEW MODEL, 32, 35, 37, 42</td>
<td>ROVER, 30, 32, 39, 96</td>
</tr>
<tr>
<td>NIPPON STEEL, 82</td>
<td>RUBBER, 56, 85</td>
</tr>
<tr>
<td>NISSAN DIESEL, 91, 92</td>
<td>RUN FLAT TYRES, 57</td>
</tr>
<tr>
<td>NOBLE, 36</td>
<td>S, 1, 11, 19, 22, 32, 34, 35, 37, 40, 41, 42, 43, 44, 45, 46, 56, 57, 58, 60, 61, 64, 66, 71, 77, 86, 90</td>
</tr>
<tr>
<td>NOISE, 1, 45, 46, 63, 64, 91</td>
<td>SAFETY, 1, 23, 25, 35, 47, 48, 49, 50, 54, 58, 91</td>
</tr>
<tr>
<td>NONLINEAR, 49, 52, 58, 66</td>
<td>SAFETY DEVICES, 49</td>
</tr>
<tr>
<td>NORTH AMERICA, 91</td>
<td>SALOON, 23, 25</td>
</tr>
<tr>
<td>NOX, 60</td>
<td>SCANIA, 14, 73, 97</td>
</tr>
<tr>
<td>NVH, 1, 45</td>
<td>SEAT, 19, 31, 38, 50</td>
</tr>
<tr>
<td>OCCUPANT PROTECTION, 91</td>
<td>SEAT BELT, 50</td>
</tr>
<tr>
<td>OEM, 29, 55, 77</td>
<td>SEAT BELTS, 50</td>
</tr>
<tr>
<td>OIL, 69</td>
<td>SEATING, 51</td>
</tr>
<tr>
<td>OPEL, 63, 71, 96, 97</td>
<td>SECOND HAND, 39, 42</td>
</tr>
<tr>
<td>OPTICS, 75</td>
<td>SEMICONDUCTORS, 81</td>
</tr>
<tr>
<td>OPTIMISATION, 52</td>
<td>SENSITIVITY ANALYSIS, 52</td>
</tr>
<tr>
<td>PACCAR, 13</td>
<td>SENSORS, 49</td>
</tr>
<tr>
<td>PACKAGING, 95</td>
<td>SHELLS, 73</td>
</tr>
<tr>
<td>PASSANGER, 19, 71</td>
<td>SIGNALLING, 2, 75</td>
</tr>
<tr>
<td>PASSNGER CAR, 19, 71</td>
<td>SILICON, 87</td>
</tr>
<tr>
<td>PEDESTRIANS, 19</td>
<td>SIMULATE, 45, 46</td>
</tr>
<tr>
<td>PENSKE, 53</td>
<td>SIMULATION, 19, 20, 21, 53, 54, 56, 60, 66, 81, 90, 93, 95</td>
</tr>
<tr>
<td>PETERBILT, 13</td>
<td>SIMULATIONS, 21, 57, 58, 60</td>
</tr>
<tr>
<td>PEUGEOT, 19, 25, 33, 41, 42</td>
<td>SISU, 13</td>
</tr>
<tr>
<td>PITTING, 72</td>
<td>SIX STROKE CYCLE ENGINES, 59</td>
</tr>
<tr>
<td>PLASTIC, 69, 84</td>
<td>SKODA, 19, 31, 96</td>
</tr>
<tr>
<td>PLASTICS, 84</td>
<td>SMART, 19, 61</td>
</tr>
<tr>
<td>PLATE, 89</td>
<td>SMART CAR, 61</td>
</tr>
<tr>
<td>POLYESTER, 73</td>
<td>SNOW, 92</td>
</tr>
<tr>
<td>POLYPROPYLENE, 79, 80, 81, 84</td>
<td>SPACE FRAMES, 89</td>
</tr>
<tr>
<td>PORSCHE, 38</td>
<td>SPARK, 62, 63, 68, 69</td>
</tr>
<tr>
<td>POWERTRAIN, 23, 28, 62, 72, 93</td>
<td>SPARK IGNITION, 62, 63, 68, 69</td>
</tr>
<tr>
<td>POWERTRAINS, 2, 73</td>
<td>SPARK IGNITION ENGINES, 62, 68, 69</td>
</tr>
<tr>
<td>PRESSURE, 67</td>
<td>SPEED, 46</td>
</tr>
<tr>
<td>PRICING, 14</td>
<td>STABILITY, 28, 54</td>
</tr>
<tr>
<td></td>
<td>STABILITY CONTROL SYSTEMS, 28</td>
</tr>
</tbody>
</table>

101
AUTOMOBILE ABSTRACTS ORDER FORM

Copies of articles listed in Automotive Business News are generally available at the following costs:

<table>
<thead>
<tr>
<th></th>
<th>SAE Members</th>
<th>Non SAE-Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE papers (in Print latest 3 years)</td>
<td>£7.35</td>
<td>£10.50</td>
</tr>
<tr>
<td>SAE Papers (out of print)</td>
<td>£9.10</td>
<td>£13.00</td>
</tr>
<tr>
<td>MIRA Members</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Documents (up to 10 pages)</td>
<td>£4.00</td>
<td>£5.00</td>
</tr>
<tr>
<td>over 10 pages</td>
<td>£8.00</td>
<td>£10.00</td>
</tr>
</tbody>
</table>

Please Note that provision of document copies must comply with requirements of the Copyright, Designs and Patents Act, 1988. Therefore we may only be able to supply part of the work or may need to refer you to the publisher to supply the full document.

Please supply me with the following item(s). Order by MIRA DOC Number.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

I declare that I have not previously been supplied with a copy of these originals by any librarian, and I understand that if a copy is supplied to me in compliance with this request, I will not use it except for the purposes of research or private study and will not supply a copy to any other person. Also, to the best of my knowledge no other person with whom I work or study has made or intends to make, at or about the same time as this request, a request for substantially the same material for substantially the same purpose.

Signed .................................................... Printed ____________________________

Company _____________________________________________________________
Address ______________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Invoice me/ my company ☐ Charge to my deposit account, less 5% ☐
Charge to my Visa/Access/Mastercard ☐
Cash with order ☐

Official Order No: __________________________ Card No: __________________________
Expiry date: __________________________ Cardholders address: __________________________