



# GET A GRIP

TYRES, ROAD SURFACES  
AND TRAFFIC ACCIDENTS

## The AA Motoring Trust

The AA Motoring Trust was established by the AA in 2002 to continue its historic role as the champion of the interests and safety of Britain's road-users.

The AA Trust has a particular focus on research and programmes that promote road safety, particularly child safety.

Current and recent work includes

- Mapping Britain's safest and least safe major roads
- Crash-testing new cars
- Crash-testing child car seats
- Research to show the dangers to children caused by badly-fitted child car seats
- Research that identifies how, where and when children are injured on roads
- Research that will help to improve the standards of teaching road safety to children
- Assessing the safety of road tunnels

## County Surveyors' Society

The County Surveyors' Society (CSS) represents local authority chief officers with responsibility for

- Strategic planning
- Transportation
- The environment
- Waste management
- Economic development

The society's membership is drawn from the four countries of the United Kingdom. Its members are responsible for two-thirds of the road network in England and Wales, all public roads in Northern Ireland and have close relationships with the Society of Chief Officers of Transportation in Scotland (SCOTS) whose members have responsibility for all but 6 per cent of public roads in that country.

The society's aims are to represent its members' interests by the development and dissemination of best practices, by promoting initiatives aimed at influencing government policy, and by responding to European and central government initiatives and consultations.

The information in this booklet is published by The AA Motoring Trust (registered in England, charity number 1091932). It has been developed from a review<sup>1</sup> of research conducted by Hampshire County Council and managed by TRL on behalf of the AA Foundation for Road Safety Research (registered in England, charity number 295573) and the County Surveyors' Society. The views are those of the author and do not necessarily reflect those of the County Council or of the funding partners.

<sup>1</sup>Bullas, John C. (2004). *Tyres, road surfaces and reducing accidents: a review*. The AA Foundation for Road Safety Research/County Surveyors' Society. Available at [www.AAtrust.com](http://www.AAtrust.com) and [www.cssnet.org.uk](http://www.cssnet.org.uk).



**Bert Morris**  
Director, The AA Motoring Trust



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New tyres come with at least 7mm of tread. On a new road surface they can stop a car travelling at 60mph in less than 50 metres. But what about a typical car on a typical road? How confident can drivers be that they, and the cars behind, can pull up quickly in an emergency? The risks are many times greater if tread depths are close to the legal limit and the emergency is on a wet, worn-out road surface.

The AA Motoring Trust and the County Surveyors' Society have jointly funded a review of tyres, road surfaces and road accidents. This report summarises and develops the key findings and advice. Surprisingly, it is the first of its type to probe the real-world combination of tyres and the roads that people drive on daily.

Every year there are 5 million road traffic accidents in Britain, resulting in about 35,000 fatal or serious injuries. In every crash, and in millions of near misses, how well that small area of rubber and road grip each other can be a matter of life and death.

The AA Trust-CSS review shows that, at busy sites where road surfaces are subjected to excessive wear (about 10 per cent of the network) and fall below thresholds set by first-level safety checks ('investigatory levels'), the number of skidding accidents in the wet increases by almost 50 per cent. About one mile in six of the principal road network currently falls below these thresholds.

To make matters worse, 10 per cent of British motorists drive with at least one tyre that has so little tread left on it that it is illegal.

Motorists must not shirk their basic responsibility to maintain their cars to required standards. But it is vital that road authorities also fulfil their responsibilities. They need to have, and to use, sufficient funds and to adopt the right procedures to provide high-quality road surfaces.

Our report reveals the potential of new road surfacing techniques and new tyre technology. It also contains sensible advice for motorists, tyre suppliers, garages, trading standards officers and road authorities. In the short term

- Local councils must understand and carry out their legal responsibilities to maintain roads: few other budgets have such an influence on life and death in their communities
- Owners and operators of garages and filling stations must ensure that air equipment is working and properly calibrated and trading standards officers should check this
- Motorists must check their tyres' air pressure weekly, and accept that the legal limit of 1.6mm tread depth is the point at which tyres are so bad that they break the law and put themselves and other road-users at greater risk

In the medium term, we must all start to take accidents that happen on the roads and result in death or severe injury as seriously as accidents that happen in the air, on the railways and in the workplace. There is a need to

- Establish computerised records of the road surface condition as well as tyre type and condition in every fatal crash
- Ensure that best practice becomes universal for recording all maintenance carried out on roads

The government should lead a review of the 1.6mm tread depth limit in the light of research evidence from real crashes.



# TYRES

Good tyres on good surfaces - not the norm

## Worn tyres

- Worn tyres are common. One in 10 cars has one or more tyres with a tread depth at or below the legal (1.6mm) limit. Research more than 30 years ago produced broadly similar results.
- Worn tyres reduce braking capability on wet roads and severely increase the risk of accidents.
- Tyres with less than 1mm tread depth have a braking friction in the wet that is just one-third that of tyres with the minimum legal tread depth of 1.6mm.

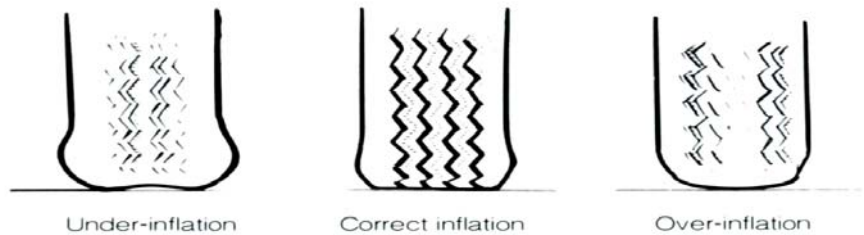
## Tyres on wet roads

- Stopping distances in the wet are doubled.
- Worn tyres contribute to about one in 10 accidents in wet conditions, compared to one in 50 accidents on dry roads.
- Grip on wet roads is markedly reduced when tread depth is less than 3mm.
- When there is a 2mm film of water on the road, even 2mm of tread may give no better stopping friction than a bald tyre.
- On wet roads, the risk of an accident trebles if the tread depth is at the 1.6mm legal minimum, and it increases seven-fold when the tread depth is less than 0.5mm.

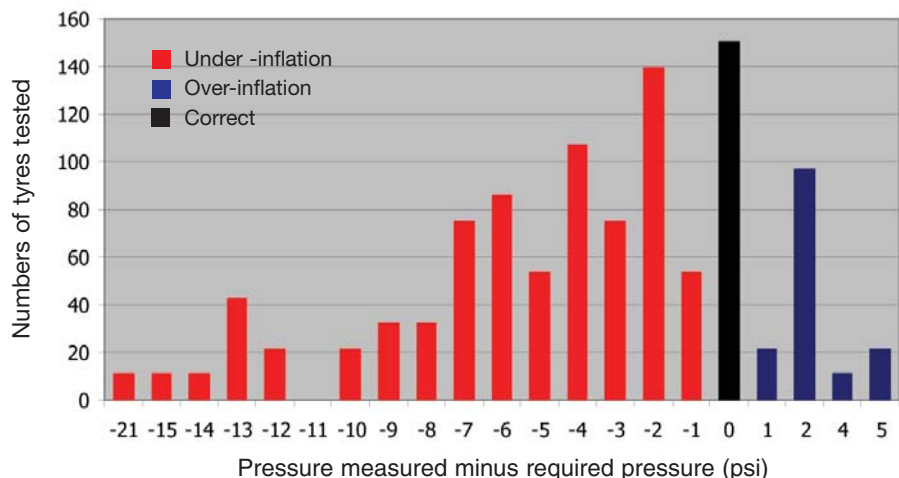
## Tyre imbalance

- Different tread depths on front and rear tyres create handling problems.
- Vehicle handling is affected when the tread depth is substantially greater on the front tyres than on the rear tyres.

Typical appearance of under- or over-inflated tyres



Tyre Industry Council survey of 1072 tyres



Under-inflation was common in this 2002 Tyre Industry Council survey

## Under-inflated tyres

- Under-inflated tyres are common. Three in four tyres are under-inflated. Low pressure leads to excessive tyre wear and an increase in fuel consumption; it can also cause vehicle-handling problems.
- Just one in 20 tyres is correctly inflated.
- Tyre life decreases by up to 10 per cent for every 10 per cent under-inflation.

## Structural defects in tyres

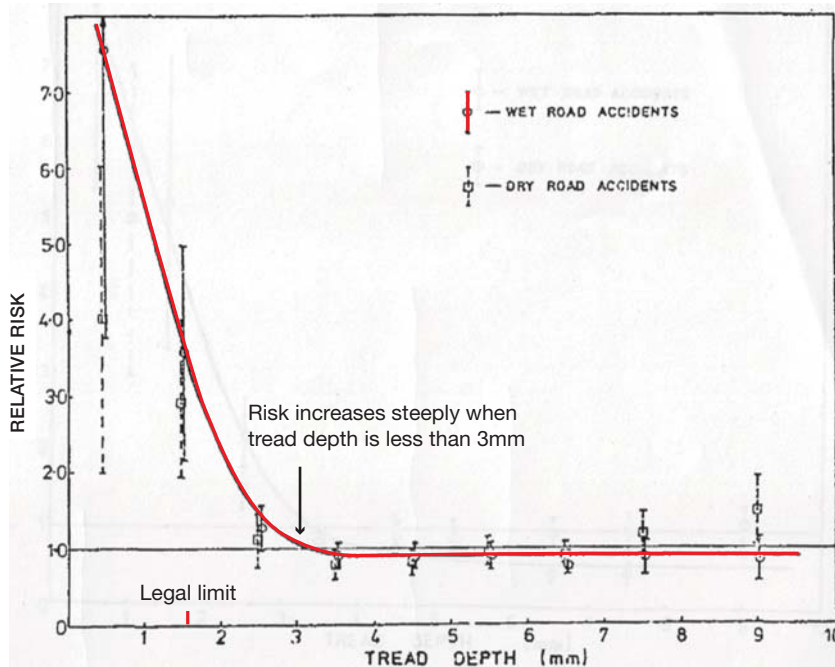
- Tyre quality and performance have improved in recent years and continue to do so with the development of so-called smart-tyre technology, with electronics monitoring tyres and warning of problems.
- Structural failures in tyres are responsible for only 3 or 4 per cent of accidents. These are usually the result of a tyre running for an extended period at low pressure or suffering damage before the accident occurred.

## Accident risk

- Vehicles of drivers found to be at fault in high-speed accidents were found to be six times more likely to have worn tyres than those of the other drivers involved.
- Drivers of vehicles with worn tyres may have other characteristics that increase accident risk – for example, they may be younger and be driving older cars.

## Tyre pressure gauges

- Surveys of the accuracy of air pressure gauges at garages have found one in five to be defective and almost half to be inaccurate (ie, outside reasonable tolerances).



Below 3mm tread depth, relative risk increases steeply in the wet  
(Fox, Good & Joubert (1979). *Collisions with utility poles*. Australian Department of Transport. ISBN 0 642 51010 5)



Highly polished surfaces often mean low skid resistance

# ROAD SURFACES

## Surface texture

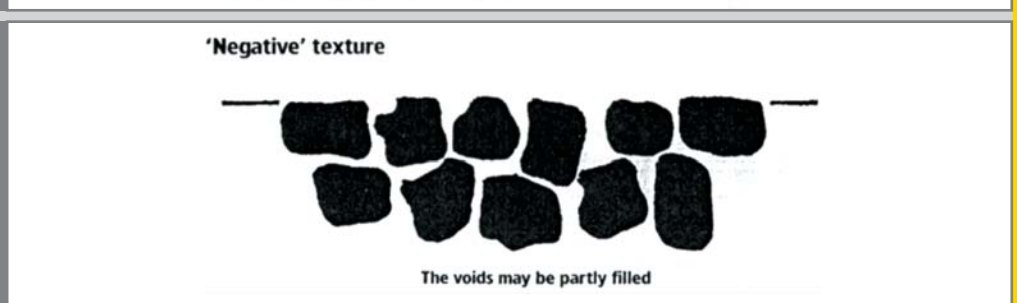
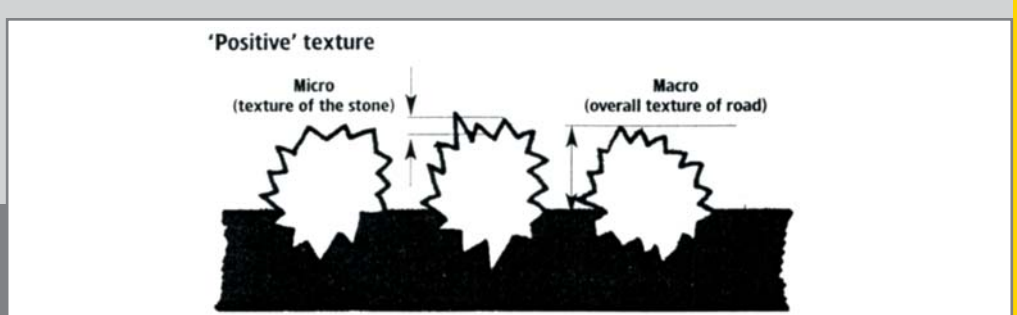
- Road surfaces have both macro-texture (the overall roughness resulting from the number, type and size of the stone chippings) and micro-texture (the roughness of the individual chippings).
- The roughness of both the macro- and micro-texture varies during the life of a surface.
- Accident rates increase markedly as the macro-texture roughness wears and smoothing of the micro-texture also decreases surface friction.

## The skid resistance standard and code of practice

- For national roads, the skid resistance standard relates the level of wet friction of the road surface to the risk of wet skidding accidents. The standard for national roads was re-issued in August 2004 (see *Design manual for roads and bridges, Vol. 7: Part 1, Section 3: Skid resistance - Highways Agency HD 28/04*).
- Sites that are found to be below the specified threshold are subjected to a more detailed examination of surface condition, accident history and the risks associated with the nature of the site. This procedure is robust if implemented correctly.
- Local authorities have a maintenance code of practice for their roads but they vary more in the extent to which they implement a standard.
- Little is known about the link between skid resistance and accidents on typical *local* road geometries and layouts.
- The means to measure dry skid resistance of newly-laid asphalt is not widely available.

## The National Road Maintenance Condition Survey

- The skid resistance indicator in the National Road Maintenance Condition Survey provides a single statistic for the overall skid resistance condition of the main road network.
- This single statistic is not directly related to the risk of an accident occurring, but does provide a first-level safety check.
- On average, about one in six of all sites on principal roads fail first-level safety checks.
- High-stress sites (such as roundabouts, sharp bends and steep hills where there is a lot of braking) make up about 10 per cent of the total network – and two in three of such sites fail a first-level check.
- High-stress sites that fail the safety check are almost 50 per cent more likely to have a wet-skid accident than those sites that pass the check.



The difference between macro- and micro-texture (after Walsh (2000). *Out of the skid pan...* Surveyor pp12-15, 9 November)

Negative texture surfaces are those in which the surface is generally smooth but has voids or hollows. Tyres grip the surface by pressing down into the voids, unlike 'positive texture', in which the aggregate protrudes from the surface and presses into the tyres. Positive texture tends to be noisier when vehicle tyres pass over it.

- Low-risk sites make up a substantial proportion of the national road network. Sites that fail the first-level safety check have a 5 to 10 per cent greater risk of a wet-skid accident compared with sites that pass.

### New generation surfaces

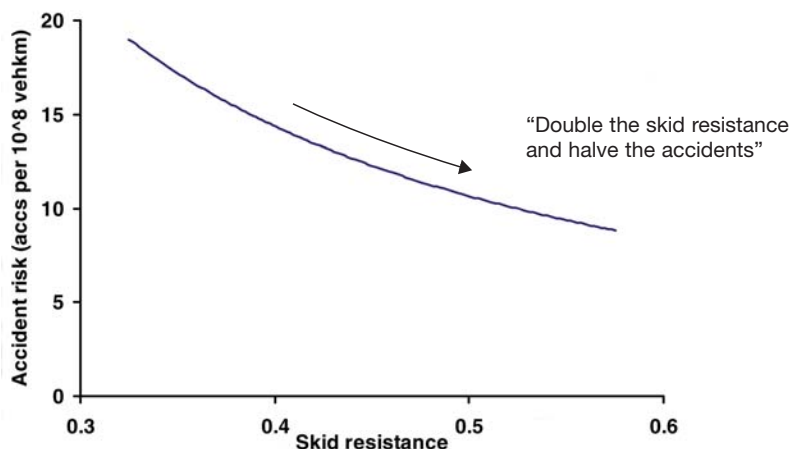
- New generation surfaces have 'negative texture' which reduces tyre noise and spray.
- Low-noise surfaces are popular with motorists and residents alike. Government has proposed that 60 per cent of the national road network should be low-noise by 2011.
- Some freshly-laid surfaces have a lower skid resistance than after traffic has used them for some time. They can be as slippery in the dry as in the wet for the first weeks and months.

### Retexturing

- Retexturing is usually done by 'scarifying' or roughening the existing surface.
- Retexturing can be an effective short- to medium-term way of restoring skid resistance and texture depth to a sound road surface that has poor micro- and macro-texture.
- Retexturing may provide a quicker surface treatment than conventional resurfacing techniques.
- Retexturing may cost only 10 per cent of the price of resurfacing and is environmentally friendly, partly because it does not require new materials such as scarce premium aggregates.
- But retexturing may only be a short-term solution on highly trafficked or stressed sites.

### High friction surfacing

- High-friction surfaces are extremely effective in reducing accidents at high-risk sites.
- On bends, high-friction surfacing can reduce accidents by half.
- High-friction surfacing can now be specified through an approval scheme (the British Board of Agrément Highway Authorities Product Approval Scheme – see [www.bbacerts.co.uk/frames.html](http://www.bbacerts.co.uk/frames.html)). This ensures appropriate performance at high-stress and highly-trafficked locations.
- High-friction surfacing is not a panacea for all high-stress sites. Among considerations, treatment has to be matched to how long the product is likely to last at the site.



On single carriageways accident risk approximately halves as skid resistance doubles over normal ranges (after Viner, Sinhal & Parry (2004). *Review of UK skid resistance policy*. Surf2004, Toronto, Canada)



# SPRAY, WEATHER, RISK AND DATABASES

## Spray reduction

- New-generation road surfaces can reduce road spray.
- Current regulations (introduced in 1984 and 1991) limit measures to improve the suppression of spray from vehicles. To increase visibility for drivers behind, the standard should be more closely related to how much spray is reduced.
- Many trucks are exempt from UK legislation restricting spray. They include vehicles from other countries, those under 12 tonnes and bulk tankers and tippers.



Spray suppression specifications must be based on how much spray is reduced

## Weather and the seasons

- The skid resistance of a road surface will vary according to recent weather and the levels of detritus on the road.
- Less rainfall in summer generally means that the surface friction of a road is lower compared with the winter, although of course ice on roads also increases slipperiness.

## Accident risk

- Worn tyres running on worn surfaces greatly increase accident risk, especially in the wet. The key factors to do with road-tyre interaction determining accident risk are well known, but bear repeating. They include
  - Vehicle speed;
  - The road surface texture and skid resistance;
  - The road shape and geometry;
  - The properties of the tyre rubber and how it performs when hot;
  - The temperature and deformation of the tyre;
  - How much of the tyre is firmly in contact with the road;
  - The extent to which water is forced from the contact patch between the tyres and the road; and
  - The presence of any local contaminants on the road, such as oil or detritus.



About 35,000 fatal and serious injuries in Britain each year





## STATS19 database

- STATS19 (T1 in Northern Ireland) is the legally-required record of road accidents involving personal injury. It is a valuable and continuously improving database of information on personal injury road accidents in the UK.
- STATS19 provides data, recorded by the police after the event, about the general layout of the accident location, the time and weather, and the vehicles and casualties involved.
- STATS19 lacks detailed information on the nature of the tyre-road interface.
- A new section improving the availability of data on contributory factors in accidents is providing vital new information about vehicle defects and environmental conditions.

## Contributory Factors

Contributory Factors ("Stats 20" references: 5.1, 5.5, 5.9, 5.13, 5.17, 5.21)

**Driver/Rider Error or Reaction**

- 401 Junction overshoot
- 402 Junction restart
- 403 Poor turn or manoeuvre
- 404 Failed to signal/Misleading signal
- 405 Failed to look properly
- 406 Failed to judge other person's path or speed
- 407 Passing too close to cyclist, horse rider or pedestrian
- 408 Sudden braking
- 409 Swerved
- 410 Loss of control

**Impairment or Distraction**

- 501 Impaired by alcohol
- 502 Impaired by drugs (illicit or medicinal)
- 503 Uncorrected, defective eyesight
- 504 Illness or disability, mental or physical
- 505 Not displaying lights at night or in poor visibility
- 506 Driver wearing dark clothing at night
- 507 Cyclist using mobile phone
- 508 Distraction in vehicle
- 509 Distraction outside vehicle
- 510 Aggressive driving
- 601 Aggressive driving - overtaking in a hurry

**Vehicle Defects**

- 201 Tyres illegal, defective or under inflated
- 202 Defective lights or indicators
- 203 Defective brakes

**Road Environment Contributed**

- 101 Poor or defective road surface
- 102 Deposit on road (eg. oil, mud, chippings)
- 103 Slippery road (due to weather)
- 104 Inadequate/masked signs or road markings
- 105 Defective traffic signals
- 106 Traffic calming (eg speed cushions, road humps, chicane)s, band, hill, narrow carriageway)
- 107 Temporary road layout (eg contraflow)
- 108 Road layout (eg bend, hill, narrow carriageway)
- 109 Animal or object in carriageway

**Vehicle Record**

2.16 First Point of Impact

2.17 Other Vehicle Hit

2.18 Part(s) Damaged

2.21 Sex of Driver

2.22 Age of Driver

2.23 Breath Test

2.24 Hit and Run

2.25 Driver's License

2.26 Vehicle Status

2.27 Driver's License

**Accident Record**

1.1 Record Type

1.2 Police Force

1.3 Accident Ref No

1.4 Road Type

1.5 Number of Vehicle Records

1.6 Number of Casualty Records

1.7 Date

1.8 Time of Day

1.9 Local Authority

1.10 Location

1.11 Location

1.12 1st Road Class

1.13 1st Road Number

1.14 Road Type

1.15 Speed Limit (mph)

1.16 Junction Detail

1.17 Junction Control

1.18 2nd Road Class

1.19 2nd Road Number

1.20a Pedestrian Crossing - Human Control

1.20b Pedestrian Crossing - Physical Facilities

1.21 Light Conditions

1.22 Weather

1.23 Road Surface

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# RECOMMENDATIONS

## For motorists

Buy a tyre pressure gauge, and check the general state of vehicle tyres and tread depth weekly. Check air pressure when tyres are cold.

When the tread depth reaches 3mm, take care to monitor the tread that remains since tyre grip on wet roads is markedly reduced below this depth.

Ideally, replace the tyres soon after the tread depth reaches 3mm. Always replace them once the tread is worn down to 2mm or less at any point around the circumference in the central three-quarters of the tread.

For safety, tyres must be correctly inflated and free from damage.

It is illegal to drive a car that has a tyre with a tread depth of less than 1.6mm at any point around the circumference in the central three-quarters of the tread.

Reduce speed to suit wet weather conditions – even with the best tyres in the world a car cannot go round a corner as fast in the wet as in the dry.

Take care at all times of the year – in summer months roads are especially slippery after rain.

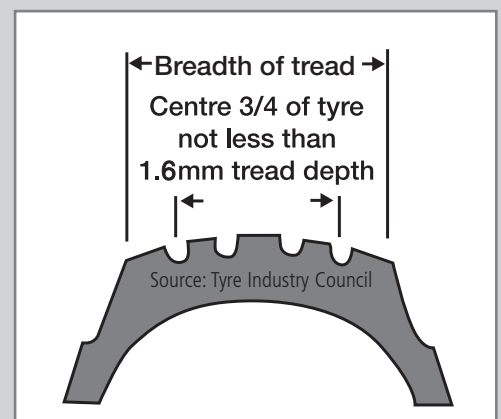
When replacing two worn tyres, as a general rule, arrange the tyres so that the two new ones go on the rear wheels.

Tyres need to be suitable for the vehicle and for the wheels they are being fitted to (front or rear). Care is needed when mixing tyre types, particularly when low-profile, asymmetric or directional tyres are fitted.

Do not buy used (part-worn) tyres.

### Tread depth

The legal minimum tread depth for car tyres in the UK and the European Union is 1.6mm throughout a continuous band comprising the central three-quarters of the breadth of tread round the entire outer circumference of the tyre.



## For the tyre industry

Increase industry-funded research on the role of tyre characteristics in real-world accidents.

Continue to promote the message that, when customers are buying new tyres in pairs, they should be fitted to the back wheels, not the front.

Increase research on the contribution to accidents of tread-depth differences between front and rear tyres.

Develop affordable technologies that will maintain tyre pressure consistently, such as reliable on-board tyre pressure monitoring.

Ensure that tyre pressure gauges are easy to use and accurate – or are withdrawn from service.

Check the accuracy of tyre pressure equipment regularly to ensure compliance.

Re-design the National Road Maintenance Condition Survey to give more meaningful skid resistance measures linked to the risk of accidents.

For national roads, ensure that there is ongoing monitoring of the effectiveness of the new skid resistance standard that was issued in August 2004.

For local authority roads, tailor the local authority skid resistance code of practice and apply it consistently.

Ensure that de-trunking of national roads does not reduce the level of skid resistance monitoring on some busy roads.

Follow best practice guidelines as to the friction characteristics of asphalt material shortly after being laid; improve the early life 'grip' of some of these surfaces.

Use the Highways Agency and County Surveyors' Society guidance on the assessment and mitigation of the risk associated with newly-asphalted surfaces.

When appropriate, consider retexturing (rather than replacing) road surfaces; it can provide a rapid, cheaper and more environmentally-friendly short- or medium-term solution.

Decide whether high-friction surfacing is the most appropriate treatment to use. Collect up-to-date data on the performance of these materials that will test their value at particular sites.

Encourage the European Commission to develop a performance-based specification to suppress spray from large vehicles; encourage the UK government to review current spray suppression exemptions in order to improve driving conditions in the wet.

Increase research that will provide advice to local authority engineers on the link between skid resistance and accidents for typical local road geometries and layouts.

Establish computerised records of the road surface condition and the tyre type and condition for every fatal crash.

Ensure that best practice in recording all maintenance carried out on a road becomes universal.

Develop the 'contributory factors' data in the STATS19 national accident reporting form.

Use data mining to complement established analysis techniques of local authority accident data.

Revitalise and re-launch the national Monitoring of Local Authority Safety Schemes database (MOLASSES); encourage practitioners to submit data and to use the system.

**For garages and trading standards officers**

**For road authorities and the surfacing industry**

**For data analysts**

“Local councils must understand and carry out their legal responsibilities to maintain roads: few other budgets have such an influence on life and death in their communities”

“Owners and operators of garages and filling stations have a responsibility to ensure that air equipment is working and properly calibrated”

“Motorists must check their tyres’ air pressure weekly, and accept that the legal limit of 1.6mm tread depth is the point at which tyres are so bad that they break the law and put themselves and other road-users at greater risk”

“...we must all start to take accidents that happen on the roads and result in death or severe injury as seriously as accidents that happen in the air, on the railways and in the workplace. There is a need to

- Establish computerised records of the road surface condition as well as tyre type and condition in every fatal crash
- Ensure that best practice becomes universal for recording all maintenance carried out on roads

The government should lead a review of the 1.6mm tread depth limit in the light of research evidence from real crashes.”

[www.AAtrust.com](http://www.AAtrust.com)

The AA Motoring Trust

Southwood East, Apollo Rise, Farnborough, Hampshire GU14 0JW

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