BLOWOUT
Bold new research

A front tyre – or steering axle tyre – blowout can lead to a catastrophic event with the driver losing control, spinning out, veering off-line or worse, rolling over. While there have been countless sudden deflation cases on commercial vehicles, there has never been a sudden-deflation, real-life test done in South Africa to determine how the risk can be reduced. It is thus that *Craig Proctor-Parker*, managing director of Accident Specialist, gathered together a team to conduct such a test. It was an amazing exercise attended by *FleetWatch* technical editor *Dave Scott*, who in this article spells out what was involved and urges for more concentration to be placed by operators on this vital aspect of road safety.

▲ This huge crash which took place on the R24 in 2010 was caused by a steering axle tyre blowout on a truck which then veered across the centre isle into on-coming traffic causing damage to a number of vehicles and the unfortunate death of one person. It is to avoid situations like this that Craig-Proctor Parker and his team have done research into steering axle blowouts.

SETTING UP

▲ Thulane Ndawo, action man with 10 years' experience at Bridgestone provided invaluable input for the test exercise.

In 2022, there were about 1.446 billion vehicles driving around on Earth. South Africa's share of this - in July 2022 - was 11,897,500 vehicles - 0,82% of the world's total. That means we only have an approximate 1% share of the global vehicle population. So why worry? Here's why….

The cumulative South African statistics are reason for great concern as 1,7-million South Africans are involved in more than 800 000 road traffic crashes (RTC's) every year. The total annual cost runs into billions – well over R400-million every day.

And inside this massive economic loss is a steering axle on every vehicle with two tyres making two small footprints on the road. That's a conservative 22 million steering-axle tyres that hit the road every day in South Africa. It is the steering tyres that give a vehicle direction through friction generated by the tyres with the road surface. Its simple - no friction, no direction and that is why a working ABS braking system with

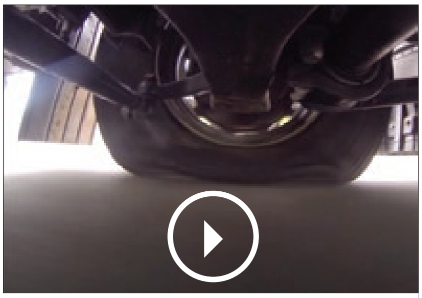
▲ Setting up underneath the truck tractor.

▲ Major equipment sponsors were Bridgestone for tyres and Durban Truck Centre which provided the Iveco S-Way truck tractor.

good tyre tread-depth is so effective to provide steer-ability even under emergency braking and in adverse weather conditions.

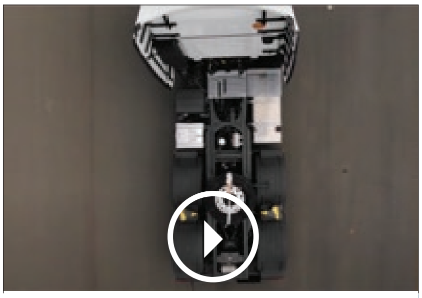
How many of the 22 million steering tyres on SA roads are in roadworthy condition? If anything is an indicator of the state of roadworthiness it is the *FleetWatch* 'Brake & Tyre Watch' tests where 69% is the failure benchmark. If we accept a failure rate of only 2% of the 22 million steering tyres plying our roads every day, 440 000 dangerous tyres would need to be removed, immediately!

WATCH THE VIDEOS



Overview of the deflation test

https://www.youtube.com/watch?v=iHusIN3Kq04



Aerial view of evidence

https://www.youtube.com/watch?v=166UAFbXI6Y

▲ All hands on deck on readying the wheel for fitment of the deflation device. Thulani Ndawo (left), Craig Proctor-Parker (far right).

It is probably the most popular statement in a court action following a road traffic crash: "The steering tyre failed. It was an accident – I could not brake in time or steer past the obstruction." Tyres do not just 'fail' - there are cumulative reasons. ▶ 10

EQUIPMENT

▲▶ The deflation device being fitted to the rim and then tightly fastened. The device itself was designed and made specifically for this project which, in itself, was a feat of engineering excellence with no margins for error.

▲ The data logger in the cab was connected wirelessly to various input points.

▲ A high definition GoPro camera was fixed to the cab to track the wheel and tyre during the test.

Craig Proctor-Parker, managing director of Accident Specialist, says he did extensive research and reading up on the issue of sudden deflation of a steering tyre and noted that there is little to no real world testing undertaken on an actual steer wheel sudden deflation – not only in South Africa but globally. "There have been a few tests modelled mathematically and in software but we couldn't find a live test," he says.

Setting up a physical on-road, real-life test in SA

Based on his experience investigating hundreds of crashes with countless sudden deflation cases involved, particularly on commercial vehicles, he decided to put together a top-notch team to lead the research by doing a real life test in South Africa. So the embryo of an idea from more than 10 years ago was brought to reality on the KZN Toyota test track earlier this year.

We posed the question – why and what is the purpose of conducting sudden deflation tyre tests? Observes Proctor Parker: "We must determine what forces are generated at the wheel (tie rod end) and in sequence, the force that translates through the steering system at the steering wheel that the driver has to deal with. Driver reactions to a sudden deflation are a major contributor to disastrous outcomes in a sudden deflation – driver training that is specific to such situations is crucial."

On-road sudden deflation tests provide physical evidence results: On the road, on/in the tyre, on the wheel/Mag, and finally on the vehicle, including the movement and dynamics which the vehicle suffers. Obviously one of the main objectives was to determine if the vehicle can be controlled in some manner to stabilise or reduce the chance of complete loss of control?

MSc Candidate student, Amaan Rampath notes: "This is better explained as a situation where the steering tyre of a vehicle either ruptures due to a sudden tear in the tread/side wall of the tyre or the de-seating of the tyre bead from the rim, which causes air to suddenly release or blowout from the tyre."

Specialised equipment required

The key-piece needed to conduct this test is a rim-mounted blowout device under the following parameters:

- Can the device suddenly deflate air from the tyre in 0.8 seconds or less to simulate a natural blowout?
- Can the device be self-powered and controlled wirelessly to not disturb the natural nature of a sudden deflation?
- Is the device light weight enough to not disturb the naturalistic nature of a blowout?

IDEAL CONDITIONS

▶ All kitted out and ready to rock – but not roll – down the Toyota test track in Durban on South Africa's first ever live steering tyre sudden deflation test.

▼ A drone was used to survey the test area and record the tyre scuffs on the tar surface from above.

▲▶ A close up of the intricate deflation device fitted and on the right, Amaan Rampath, the student using the project as a base for an MSC thesis does post-test checks of deflated tyre.

Add to the blowout device a tyre pressure monitoring system (TPMS)

- Can the TPMS record and transmit pressure signals to a receiver in time over a long distance to the receiver?
- Can the TPMS be wireless, battery powered and light weight enough to not disturb the naturalistic nature of a blowout?

Add to all this is a blowout detection system:

- Can the system receive the data in time and over a long distance without being affected by interference?
- A unique aspect of the system is that it operates wirelessly – it is all on radio signals.

And finally, the Blowout Accident-Avoidance System (BAAS):

- Can the system accurately activate in time and counteract the blowout using the pre-existing devices in the truck?

Blowouts can, and do happen, even where every effort is made to be as exemplary as possible with tyre and vehicle care. Highlighting these dangers in general is important and is a key indicator to maintain vehicles, tyres, wheels and all systems (inspections), and to maintaining appropriate speeds.

Steering tyres need special attention

There's a tendency to treat all tyres the same on a rig. A blowout on a dual tyre set on a drive axle is not going to impact steering friction but on a steering axle tyre it can be a disaster. For that reason, standard operating procedures (SOP's) for steering tyres must be far stricter and different to drive axle and trailer tyres. An addendum attached to this article is a guideline for essential SOP installation and driver training.

A massive team effort

Proctor-Parker is the visionary and driver behind this project, making it happen when most said testing sudden deflation on a steering tyre is 'too dangerous and not worth the risk involved'. But this was not a one-man show. Here's the team: ▶ 12

- Craig Proctor-Parker, managing director of Accident Specialist.
- Professor Riaan Stopforth, University of KZN School of Mechanical Engineering.
- Amaan Rampath – student using the project as a base for an MSc thesis under Stopforth's guidance.
- Neil Bloy – Bridgestone Technical Field Engineer – 16 years Bridgestone experience
- Thulane Ndawo – Bridgestone Field Technician – 10 years Bridgestone experience.

A special mention goes to the Bridgestone team which was constantly engaged in inflating tyres and changing rims – hard work under a hot sun. Many others are acknowledged here:

- Toyota Test Track & Staff – access to facilities.
- Bridgestone – Tyres and assistance.
- Durban Truck Centre – access to their workshop facilities and use of an Iveco S-WAY truck tractor.
- Saiosh – major financial backer for Amaan Rampath's master's degree.

Obstacles that had to be overcome

The three major hurdles to getting the project into reality were:

1. Co-operation by a vehicle supplier to allow access to and use of a new vehicle was the biggest hurdle by far… for obvious reasons of their 'perceived image. However this was about compiling the results of a tyre sudden deflation and not about the vehicle. A brand new, 6X4 Iveco S-WAY made the day and worked perfectly in the blowout tests.
2. Physical constraints of the build of the actual fitted deflation device, restriction in its location and fitment process (rotating), the restricted mass of the full device, the heavy pressures – 8 Bar, rotating mass balance, complexity of "removing" the air in appropriate time (target was 0.8 seconds or as close as possible), sensitivity of the electronics, re-usability and others. Along with this, were the two major issues of specialised, custom designed and built high-tensile adaptor bolts, including the custom-built wheel air-output fitment holes on the wheel rim itself.
3. Appropriate facilities to undertake testing – in this case the Toyota Test Truck was the venue.

▲ Mission accomplished and happy with the outcome. Craig Proctor-Parker (left), MD of Accident Specialist and Professor Riaan Stopforth, University of KZN School of Mechanical Engineering.

The question is: Does this provide any validated response in legal terms for use in court action where steering tyre blowout is concerned. Rampath responds: "Yes, absolutely. This is one of the reasons why we wanted the various output results as already mentioned above. Even if the test does not cover every situation/ eventuality, it does provide us with a level of empirical data and some level of base line, from which analysis and comparisons can be made, where we never had this freely available in the past." ❑

Editor's Footnote: The accompanying photographs show the pure passion and engineering brilliance used in this exercise and while we await the full thesis to be compiled by Amaan Rampath under the guidance of Professor Riaan Stopforth of the University of KZN School of Mechanical Engineering, there are already some valuable lessons that have emerged from this test which are featured alongside.

What has also emerged as a definite from this exercise is that every operator should have a Policy and Standard Operating Procedure for steering axle tyres. Dave Scott and Craig Proctor-Parker have collaborated on drawing up such a document for operators to follow. This too is published alongside.

A follow up will be done once the thesis is completed on lessons on how drivers can react when they experience a sudden deflation on a steering axle tyre. And those lessons can then be incorporated into driver training models. As Dave Scott asks: "Will the data logger, for example, be able to take all the info gathered on the day and extrapolate it to forecast how an 8,5t GVM (gross vehicle mass) truck travelling at 100kph would behave in a sudden deflation event? How about 56t at 80kph?"

In the meantime, *FleetWatch* lifts its hat to Craig Proctor-Parker and the team for conducting this exercise. It certainly was a bold one which will not only lead to ensuring our drivers are kept safer on the roads but also puts South Africa on the global research map when it comes to steering tyre issues. Well done all. ❑

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What have we learnt

Driver training

1. There's no substitute for driver training, and correct driver control/posture. Sudden deflation is an unexpected event and sloppy attitude behind the steering wheel magnifies the loss of control. Over-reacting and going for harsh braking is an absolute no-no.

Speed

2. The field tests proved that at 40kph the driver still had directional control - although the driver did anticipate the sudden deflation to occur.

Heat

3. Heat is a tyre enemy and often presages a catastrophic failure – on-board tyre pressure monitoring systems (TPMS) can warn a driver of pressure loss that leads to massive heat build-up and a sudden deflation event. Perhaps TPMS for the steering tyres alone should be considered for the RTA Regulations?

Tread depth

4. Too many truck and car operators are incorrectly distracted by the mention of 1mm tread depth in Regulation 212 (j). Replacement of steering tyres should start at 4mm and go no lower than 3mm tread depth.

Heat is a tyre enemy and often presages a catastrophic failure

▲ Tyre impact fractures are common with the proliferation of potholes on our roads. Here is a definition: An impact break is damage inflicted on the carcass (the casing of the tyre) after the tyre comes into contact with certain obstacles. A pronounced bulge on the sidewall of the tire indicates destroyed cords inside the carcass.

Unknown elements

5. Although new vehicles with all their technology, brilliant overall systems and quality certainly make the vehicles safer - and this includes excellent tyre standards - there always remains the possibility of a sudden deflation. The nasty pothole filled with water lurks in ambush for everyone.

Conclusion

6. Craig Proctor-Parker, Prof Stopforth, and Amaan Rampath have crossed the great divide of disbelief that 'it can't be done' – all the sneering refusals to participate in these tests have been rebutted. We look forward to Rampath's MSc thesis using the material gathered on the Toyota Test Track. ❑

STEERING AXLE TYRES

Policy & Standard Operating Procedure (SOP)

This guide complies with and is in addition to Regulation 212 of the National Road Traffic Act.

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and Craig Proctor-Parker
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1. Records of date fitted, brand, and all specifications of each tyre fitted to a vehicle, including the position fitted and by whom, should be a mandatory record keeping process.
2. Only original equipment tyres may be used on a steering axle – recaps or grooving are strictly forbidden.
3. Free Rolling Tyres (FRT) tyres are not permitted on a steer axle. FRT tyres are for trailer application only. NOTE: FRT tyres are denoted FRT on the side wall.
4. Because the steer axle is used to steer a bus or truck, it is essential for tyres to have good steering properties. Steering must take place smoothly. Steering axle tyres are directional to keep a vehicle in the right direction – this requires a different tread pattern to a drive axle traction tyre.
5. Steering axle tyres must displace water – tread depth must not be less than 4mm across the entire tread pattern. 3mm is the absolute minimum pull point (extract from steering service).
6. Steering tyre pressures must be measured on cold tyres. Bleeding a hot tyre is forbidden - a loaded hot tyre will gain as much as 20% kPa on a hot day.
7. Tyre pressure readings and pressure adjustments must not be left at the sole discretion in the hands of a pump jockey (petrol pump attendant). The driver is responsible/accountable for accurate pressures and the driver must be aware (educated/trained on this issue) of significant tyre pressure differentials and possible reasons for a pressure differential, especially when tyres are being checked and inflated.

▲ Steel valve cap – preferred choice

8. Valve caps must be fitted at all times - steel caps preferred. The valve stalk must not be under stress such as bent sideways or damaged. All valves, especially dual tyres, must be accessible.
9. A tyre pressure test should be conducted every 24 hours if possible or as close to that time frame as possible – especially on long haul. Pressures should be recorded to identify the development of a slow leak.

▲ Bridgestone steering tyres require a different tread pattern to a drive axle traction tyre. This is the 315/80R22.5. Bridgestone R-Steer 001 tyre.

10. There is a tendency to load a truck against the headboard – the result is overloading the front axle and steering axle tyres. Be aware of correct load mass distribution.
11. At every long-distance stop the driver will: Conduct a quick walk-around inspection of all tyres with a focus on the steering axle for the following:
    a. Valve caps are present.
    b. Touch test – tyres warm up in service but a tyre that is seriously under-pressured develops excess heat and will be very hot in relation to other tyres on the vehicle.
    c. No stones or objects jammed into the tread pattern.
    d. No visible sidewall cuts, bulges or unusual deformation of the tread belt. ❑