



# Tuks gets stuck in the mud

Tuks engineering students shine at US Baja competition





**It is now official: the design of the CSIR TuksBaja team's off-road Baja vehicle is world-class. The team, comprising 10 Tuks engineering students, travelled to Portland in the USA in May to participate in the annual Society for Automotive Engineers (SAE) International Baja: Oregon, which is one of the largest of the six SAE Baja competitions held in the world. Although they did not win the overall competition, the Tuks team beat 76 other teams from across the USA and various other countries to win the Best Design Award.**

The SAE Baja is an international competition in which university engineering students design small off-road cars, each having the same engine, in order to compete against other universities at Baja events. The teams get judged on the car's design, manoeuvrability, ability to climb over rocks and hills and its acceleration performance. They also compete in an endurance race on an off-road track. There are currently six SAE Baja competitions in the world – three in the USA and one each in Korea, Brazil and South Africa.

The South African Sasol Baja is held around October each year and has been organised by UP since the inception of the competition in 1996. The Council for Scientific and Industrial Research (CSIR) TuksBaja team has won the design category of this competition among local universities many times.

The TuksBaja team arrived in Portland, Oregon in the USA on 26 April as the only South African

team among 77 entrants from across the world. This is the second time the TuksBaja team has competed internationally in the USA, the previous time being in 2007.

The SAE Baja Oregon officially started on 2 May when judges did engine checks on all the vehicles. "During the engine check, the judges inspect your vehicle according to very strict rules to make sure that it has in no way been modified. All teams compete with exactly the same engine, a standard 10 horsepower engine provided by Briggs and Stratton," says Wietsche Penny, captain of the CSIR TuksBaja team.

On 3 May, cars were judged according to safety standards. "Here we picked up a few minor problems because of the difference in interpretation of the rules between South Africa and the USA, so we had to do some welding and changing on the spot, but we managed to fix what was needed," says Penny.

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Prof Schalk Els, faculty advisor for TuksBaja, says it gives students vital experience to compete in international competitions like the SAE Baja Oregon: "They get international exposure, it measures our international competitiveness and exposes us to different challenges, ideas and cultures."

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"What makes this win so much more rewarding is the fact that most of the other teams have much larger budgets and more resources available to them to build their vehicles. We have won the design category in the South African Sasol Baja many times, but this award gives us the reassurance that we really are moving in the right direction. It was really great to learn that our design is up to standard worldwide."

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The team also had to do a 'sales pitch' as the first official event in the competition: "Each team gets five minutes to 'sell' their vehicle to the panel of judges. You have to convince them that your vehicle is the best one to manufacture at the most affordable price, and answer any questions that the panel may have." Brett Kent was the TuksBaja team's salesperson at this event and helped his team to achieve 11th place in this part of the competition.

### The 2012 CSIR TuksBaja winning design

The second event was the design competition, where judges evaluated all design aspects of each vehicle and asked the team members about their design of certain elements. The Tuks team was very surprised when its name was read out as the winner of the category.

What separated Tuks from the other teams was the fact that they designed their own dampers and hub reduction gearboxes for the vehicle, while all the other teams in the competition bought these. "We design these elements of the car ourselves, because we believe that it is better engineering practice to design, manufacture and test all components, so that a solution can more readily be developed in the shortest and most inexpensive

manner, instead of buying components off the shelf, which is effectively a guessing practice," Penny says.

The team does not build the entire vehicle from scratch each year. Instead, they work towards optimising the design of the vehicle in terms of its gearbox, strength, gear ratios, shock absorbers and any other aspects that were identified during a competition that could be improved. The Tuks team has been designing and manufacturing its own dampers since 2005 and has been working continuously on optimising the design.

The drivetrain setup of the TuksBaja vehicle is another unique feature that distinguishes it from other teams. Off-road vehicles will typically have a single driveshaft coupled with a central gearbox, where all the transmission occurs. However, the transmission of the TuksBaja vehicle is split up into numerous driveshaft and gearbox assemblies. The vehicle incorporates a Polaris continuously variable transmission (CVT) that mounts directly onto the Briggs and Stratton standard 10 horsepower engine. From this, a 3:1 reduction is used to increase torque and transmit the power to the hub reduction gearboxes. Here, yet another final 3:1 reduction ensures that the vehicle delivers a maximum of 642 Nm of

torque on the driven wheels at an engine speed of 2600 rpm. The team has done numerous tests on the Polaris CVT to ensure that it takes care of all the transmission of the vehicle without the driver having to change gears.

The roll cage of any SAE Baja vehicle is subjected to very strict rules and is strongly enforced by the safety inspectors. The TuksBaja vehicle features Chromoly tubing that is laser-cut from computer-aided drawings to perfect lengths and profiles, and then expertly tungsten inert gas (TIG)-welded. This Chromoly roll cage has never failed during a roll, crash or jump and can protect the driver from all foreseen hazards that are associated with the sport.

### Practical stages

After the euphoria of winning a category, the Tuks team had to prepare for the practical part of the competition that started on 4 May. It was held at the Washougal track just north of Portland.

On this day, the teams had to participate in a number of performance events on an outdoor, rough-terrain track that tested the vehicles' ability in acceleration, hill climb and rock climb, as well as manoeuvrability. The teams got two attempts at each of these events.

It is here that the TuksBaja team experienced its biggest fallback in the competition. The terrain and weather in Portland was not at all what the team expected; therefore the tyres were completely unsuitable for the wet, muddy conditions on the Washougal track.

"We tested every single important aspect of the vehicle in preparation for the event, but the tyres were the one thing we just did not think about.



The biggest lesson we learnt from our participation in this Baja was to carefully research and check the small things of the car, like the tyres, as well."

The main event of the Baja took place on 5 May in the form of a four-hour endurance race at the Washougal track. Teams had to complete as many laps as possible within four hours, on a muddy track littered with obstacles such as logs, mudbaths and riverbeds with cobbles.

Again, the tyres were the Tuks team's big downfall. Because the traction on the tyres was inefficient, they had to lower the pressure, but this led to the tyres slipping off the rims a few times. "We fared very well in the first two hours. We were one of the frontrunners in the race, but then the tyres started giving us problems," said Penny. The team was, however, very satisfied with the fact that, apart from the tyres, the vehicle experienced no other problems or technical difficulties throughout the entire race.

The CSIR TuksBaja team finished 29th overall in the competition.

### Future plans

When the team returned from the USA, they turned their attention to

preparing for the South African Sasol Baja to be held at Gerotek just outside Pretoria in mid-October. They also went on a recruitment drive at the University to get first-year engineering students to join the team.

"It is important for us to find first-years to join the team so that we can ensure that they are properly prepared to take over when the current senior team members graduate," says Penny. All students in the Faculty may apply to join the team; not only mechanical engineering students.

Prof Els has big hopes for the team in future competitions. "Our team has proven to be a worthy contender at international competition level. It certainly ranks among the world's best Baja teams in terms of mechanical design and manufacturing, leading the way with innovative ideas and implementing these extremely well. The team already has plans in place to test different tyres, especially on wet and muddy terrains, and should be much better prepared for this challenge in future. Ending in 29th place overall, despite totally unsuitable tyres, shows that the potential is there, and with the experience gained, we can take another positive leap forward."

Prof Els adds that the experience of sending the team to compete in the USA is so rewarding. "We will have to think of a very good reason why not to send them there again next year." 📍

The CSIR TuksBaja team would like to thank the following sponsors:

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Team members of the 2012 CSIR TuksBaja team:

Wietsche Penny (Captain)  
Rian Lauwrens (Vice-captain)  
Nico Bouwer (Driver)  
Brett Kent (Driver)  
Eugene Havenga  
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