October 2009
Technical Newsletter

Automotive Electronic Control Systems

AECS
Training, Equipment and Data for Automotive Diagnostic Specialists

VTEQ brake test lane at Jim Wright Nissan

Brake, suspension and side slip testers....

the facts !

AECS **Ltd is the NZ distributor of the VTEQ test equipment since 2001.** ***AECS*** is also heavy engaged in high tech automotive training throughout the country.

The **VTEQ** range of equipment is very high quality, and is designed to perform up to one test every 90 seconds all day without any problems. The VTEQ equipment is highly regarded and is sold in all parts of the world, they have been around since 1995. We became involved with VTEQ back in 1998.

In this series of technical articles, I try to explain the functions of the VTEQ brake test lane from the technical perspective to show what you can do with the machine. I will also try to wet your technical appetite about suspension and brakes.

A full test lane consists of a Side slip tester, a Suspension tester and a brake tester. Even an emission tester, sound (Db) and electronic beam setter are able to be integrated into the test lane.

Side Slip.

A Side Slip tester is one of the simplest tools ever. It is relatively low cost and it takes no extra time up during a brake/ suspension test.

The tester has an entry and an exit sensor. Both need to be activated within a set period of time before a test gets recorded. Drive too slow and the tester will ignore the test. You just drive onto the suspension tester to complete a test whilst holding the steering straight.

VTEQ side slip tester in a test lane configuration.

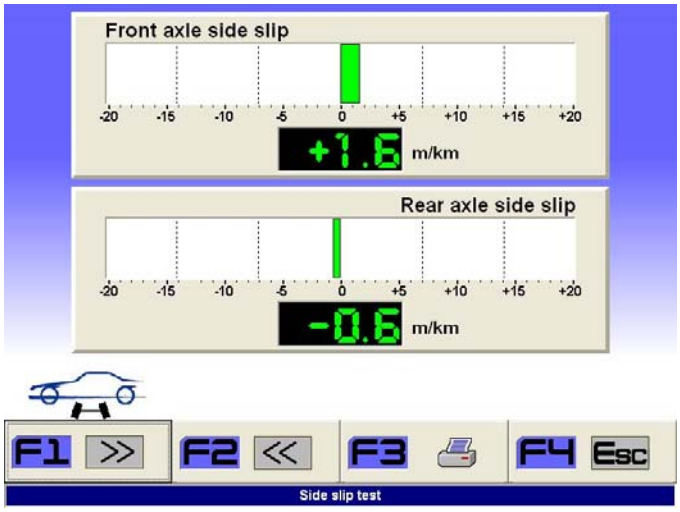
What information do you get from a side slip tester?

Simply put, when a car has toe in it will push the road 'apart' when driving straight.

The sideslip tester has a platform which measures the sideways road displacement of one wheel while the other wheel on the same axle is held firmly on the ground.

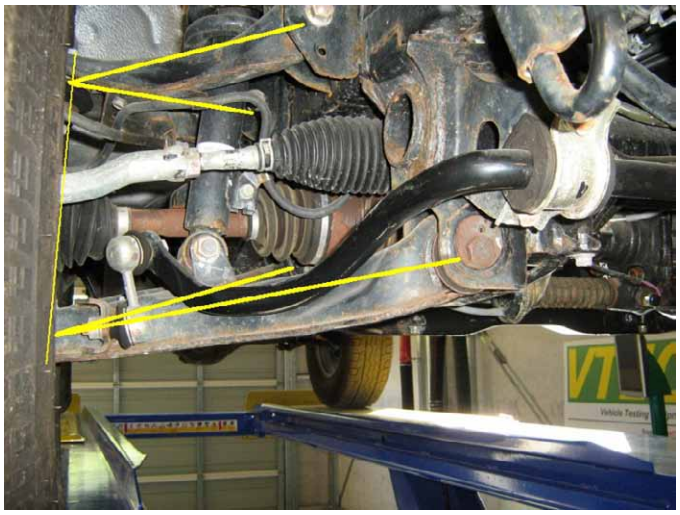
The measurement is usually displayed in m/km side-ways displacement. So the effect of toe in (positive reading) and toe out (negative reading) is simple to understand, but what about Camber or Caster, and reverse driving?

Please let your eyes do the work (p.s. all measurements are done with the same vehicle):



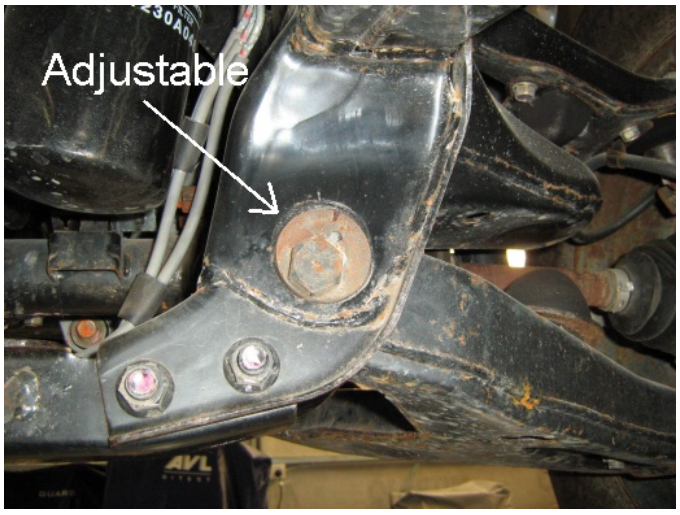
Readings with acceptable non modified wheel alignment.

The modifications will be done to the front suspension, which is a double wishbone type suspension.

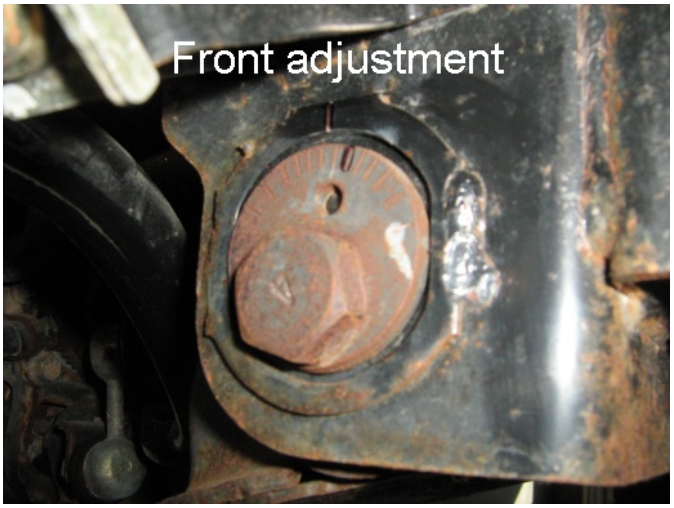


Highlighted in yellow are the lines of the top and bottom wishbone and the king pin

The bottom wishbone is easy to adjust on the front and on the rear, so is the toe.



Front bottom wishbone adjustment

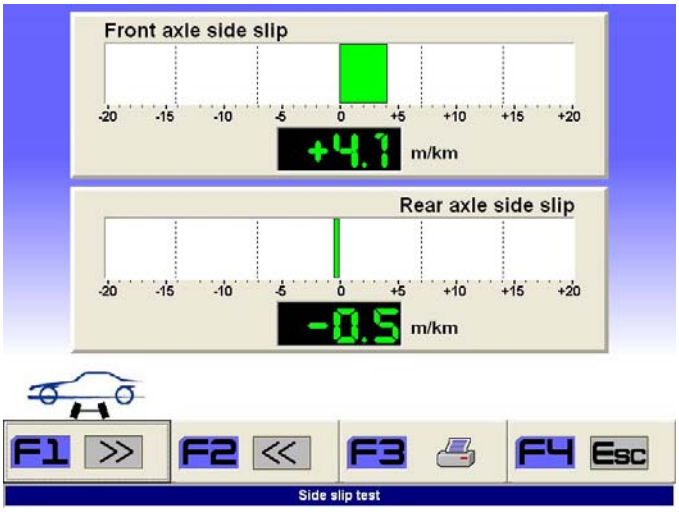


Rear bottom wishbone adjustment

Caster

The next sideslip measurement is made with the front adjuster to its max outward (about 5 mm) and with the rear adjustment to the max inward (also about 5 mm). This will bring the King pin back at the bottom (reducing caster), putting extra tension on the track rod.

After adjusting the toe to original the vehicle was driven over the sideslip tester with the following result.



Reduced caster, with correct toe.

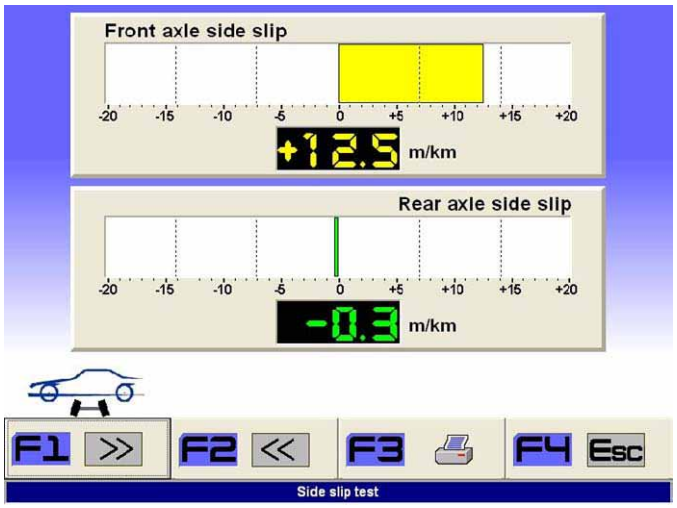
This shows clearly that a grossly incorrect caster has increased tyre wear as result, but the biggest problem would be unstable steering when driving straight.

Did you know?

We have invited our loyal training customers to subscribe to our technical support service, to help with speeding up those sticky diagnostic cases!

Camber

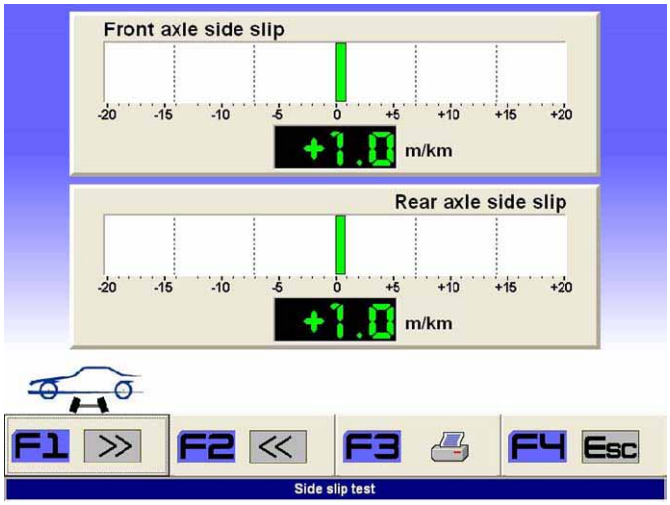
The next measurement was done with both the front and the rear of the bottom wishbone extended outwards to their max (+/-5 mm each). This brought the bottom of the king pin out, to increase KPI, or make the camber more negative. The adjustment put extra tension on the track rod, so the toe was adjusted back to original again.



Reduced camber, with correct toe

It should be obvious that incorrect camber has a bigger effect on tyre wear than incorrect caster.

Just for fun and to understand the effect of camber in wheel alignment we ran the vehicle over the tester in reverse direction.



Reduced camber, with correct toe, but driving in reverse direction.

The moral of the story is that even with the toe-in adjusted properly the car will still eat tyres. Also pushing the road apart continuously more than you should, will increase fuel consumption, but that should go without saying.

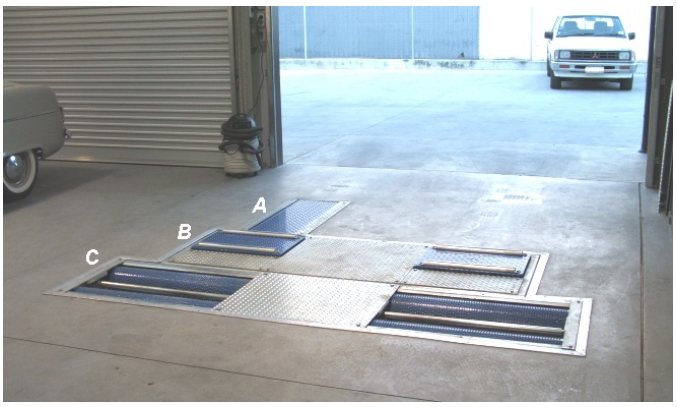
A sensitive side slip tester will indicate that there is a problem and that the wheel alignment needs to be (fully) checked without any extra effort of the operator performing the full 'brake' inspection.

Did you know?

- A whole 'drive over' from start to finish (including the brake test) takes only around 2 minutes.
- VTEQ sells these testers world wide and that they are very highly regarded.
- **AECS** spends a lot of time and resources getting trained by the factory and performing in house application research to increase the functionality of the tester for you.
- All the functions described in this article are not available or are a in basic form on Analogue brake testers.
- We are developing an ABS test module to be used with the brake tester, to be used on trucks and cars.
- **AECS** travels once a year around the country to calibrate and service all VTEQ testers with a dedicated truck. This raises the quality and the durability of your investment.

Suspension tester.

The first platform the vehicle drives over without hesitation is the sideslip tester. The second platform in the test lane that the vehicle will drive onto with both wheels is the suspension tester (B).

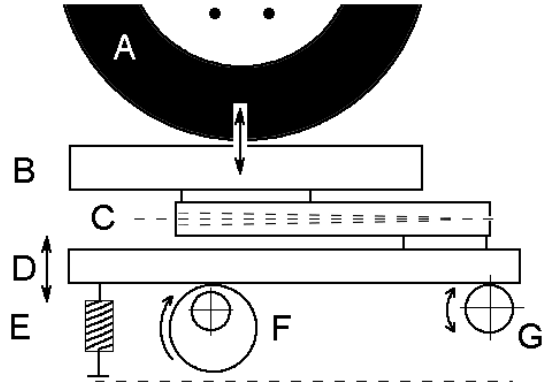


A = Sideslip tester, B = suspension tester*, C = Brake tester*

A suspension tester will evaluate the whole suspension system of the vehicle. The platforms of the suspension tester have very sensitive high speed recording weight cells.

The vehicle's static weight is taken when it is driven onto the platform. The platforms will be oscillating throughout a frequency range while continuously recording the weight on the platform.

A different description for this EUSAMA (EUropean Shock Absorber Manuf. Association) type suspension tester is ‘road contact tester’.



Eusama type suspension tester.
A =Car tyre
B = Platform
C = Weight sensor
E = Spring
F = Camshaft

The camshaft (F) rotates, moving the platform and wheel up and down throughout a frequency range, measuring via the weight sensor the road contact force. Theoretically on a perfect suspension system, the weight on the platform will remain the same during an upward and downward motion. This would result in a 100% efficient shock absorber.

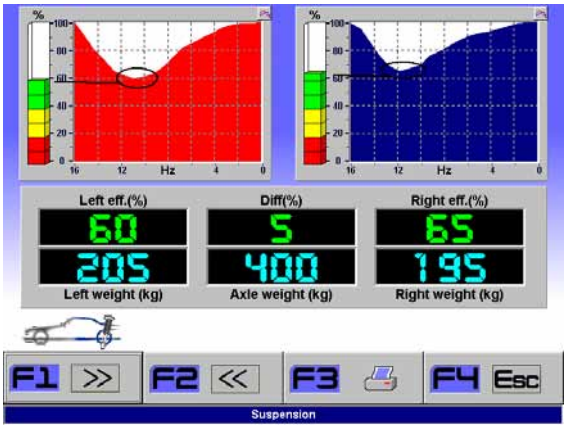
In reality the oscillating platform will try to ‘throw’ the wheel up into the air. With worn suspension components is it far easier to move just a wheel up than to move the wheel and the vehicle’s whole body up. For example with worn suspension components the wheel will lose contact with the platform just before the platform’s downward stroke, reducing the weight on the platform to sometimes even zero kg’s.

On the road with a wheel weight of zero kg’s there is no ability for the wheel to transfer brake or cornering force onto the road. Think about holding a tyre up into the air and see how much resistance it has to being moved in any direction, compare that to a nice sticky tyre with weight holding it down on the road.

The suspension needs to be checked throughout a frequency range as the bumps in the road are not equally spaced, nor is the speed of the vehicle constant. You must think of for example a wheel climbing a bump in the road, the suspension travel-speed (= frequency) depends on the rise angle of the bump and speed with which the vehicle moves across the bump.

There are testers on the market that will test only at one frequency, which is similar to pushing the vehicle down and watching or even measuring the rebound. This test is pointless as a shock absorber can function perfectly at one frequency and let’s go at a higher or lower bounce rate. The bounce rate of a vehicle is also affected by worn bushes or ball joints. Every part in a vehicle has its own vertical inertia. When the frequency of the tester matches the frequency of a loose suspension part, the wheel will be ‘thrown’ off the platform at that frequency, reducing the weight on the platform.
At any other frequency the weight will be relatively stable on the platform.

The results of a test with moderate quality suspension looks like this on the screen:



Fly off the road

The efficiency percentage of the suspension is taken at the frequency where the suspension performs at its worst, as that is the danger zone where a vehicle on the road will lose traction ‘un-announced to the driver’.
60% efficiency (at around 11 Hz on the Left) means that the weight of the tyre on the platform has been reduced (briefly) to 60% of the 205kg’s which was on the wheel.

If the driver had adjusted his brake pedal pressure to get maximum brake force on a smooth road (circuit), then hitting a bump with a rise rate of 11Hz would make the wheel lock up.

Alternatively, if the driver was cornering at a speed adjusted just not to lose grip on a smooth road (again only realistic on a circuit), then hitting the same bump with the same rise rate would make the vehicle fly off the road due to loss of grip.

A good suspension system is where the shock is adjusted to the vehicle and is capable to handle all frequency changes of that individual vehicle. It will show up in the coloured panel as a graph without a dip.

Good stiff suspension makes the performance (road holding) better?

This is a misconception! You will understand the following:

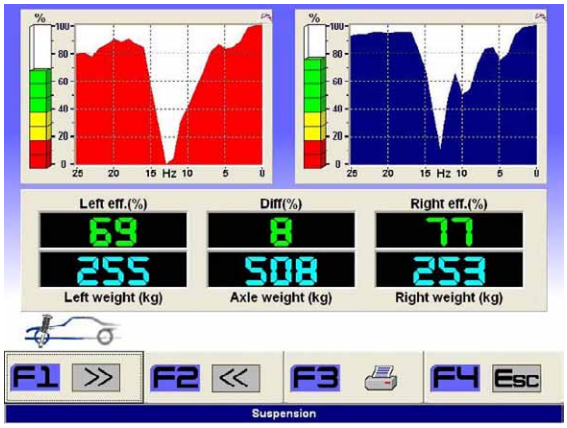
The graph below was measured on a lowered vehicle with 'nice' stiff race suspension, judge for yourself how dangerous this vehicle is:

Suspension test results of a well balanced vehicle with new 'sports' suspension, note the efficiency.

You can see that at about 13 Hz the left wheel actually comes off the platform. At first we could not believe it, we thought that the Eusama tester was incorrect. A simple test with a sheet of paper under the wheel proved the danger. We were able to pull the sheet of paper from underneath the wheel while the suspension test was in progress. How much brake or cornering force would this vehicle have on a public bumpy road?

We have seen similar results on brand new vehicles and on used vehicles with new shocks. It almost seems that on those particular vehicles the suspension is mismatched to the vehicle, or that the suspension still needs to be 'run in'.

At AECS, we sometimes get asked to change the parameters of the machines we distribute to display an average value instead of an absolute value, as that makes the vehicle's suspension seem more efficient. You make up your own mind as to what you think is correct.



Suspension test results of the same vehicle with the tester adjusted to show an average efficiency value.

Brake testing

The electronics in the test lane combines the static weight of the vehicle (measured on the suspension tester) with the brake force to come to a brake efficiency reading in the brake test results.

In a following VTEQ article I will cover brake test results and show you what brake efficiency really means. I will also explain how 'bigger brakes' or softer pads do not stop the car faster.

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AECS Training coming up:

AED	12th & 13th October	Christchurch
AED	3rd & 4th November	Auckland
DMS1-1	17th & 18th November	Auckland
AIRCON	19th & 20th November	Auckland

See our website for more details www.aecs.net