INFORMATION SHEET
#04-2012 March 2012

LOW VOLUME VEHICLE TECHNICAL ASSOCIATION Inc

Suspension Camber Angle Guide

Introduction:

This LVVTA Information Sheet provides maximum limits for negative camber, to assist LVV Certifiers who are inspecting a vehicle which has had its suspension lowered, or has had its suspension or wheel alignment geometry changed in such a way that the amount of negative camber has increased.

Background:

LVV Certifiers have been seeing an increasing trend towards vehicle modifiers introducing negative camber to allow for tight or over-sized wheel fitments in lowered vehicles. This additional camber allows for the tyre to 'tuck up' inside the mud-guard lip, meaning greater scope for a wider wheel/tyre fitment and also so that a 'race-car look' which is currently in vogue, can be achieved.

In a race-car situation, negative camber improves grip under cornering, as, during vehicle weight transfer under high cornering forces, negative camber places the tyre at an improved angle relative to the track surface, transmitting the forces through the full cross-section of the tyre width and optimising the tyre's contact patch to the track.

However, the effect of excessive negative camber in a normal road car application, particularly when wide low-profile tyres are fitted, can be to reduce a vehicle's grip level due to the reduction in the tyre-to-road contact patch, particularly during normal road driving in wet conditions.

In addition to reducing tyre life and grip, excessive negative camber on a road car can significantly reduce a vehicle's braking and cornering capabilities, and cause a vehicle to handle nervously and unpredictably. Conversely, for maximum straight-line acceleration, the maximum traction will be achieved when the camber angle is zero, and the tyre tread is flat on the road. This is why (rear-drive) race cars will typically have much more negative camber on the front wheels than the rear wheels.

It is therefore important to ensure that a road driven vehicle does not have an excessive or unsafe amount of negative camber.

LVVTA Technical Requirements:

Although there are existing technical requirements in place in both the NZ Hobby Car Technical Manual and the LVV Suspension Systems Standard which provide LVV Certifiers with requirements with which to deal with suspension geometry, these requirements don't provide any actual limits by which an LVV Certifier can determine how much negative camber is 'too much'.

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Low Volume Vehicle Standard 195-00(00)(Suspension Systems) requires that;

2.2(2)(a): "Steering mechanisms and their mountings, or any systems by which a driver controls the direction of a vehicle, must provide the vehicle with safe, efficient, convenient, and sensitive control."

2.3(8): "Low volume vehicles which have undergone significant changes to the suspension system must feature no abnormal suspension geometry, and be aligned so as to provide satisfactory handling characteristics, and ensure against excessively shortened tyre life."

2.4(1): "All modified production low volume vehicles with modified suspension systems must perform in a manner which preserves at least the quality of steering control which could be reasonably expected when the vehicle was originally manufactured."

Expert opinions sought and obtained:

In order to determine a reasonable negative camber limit, the opinions of all LVV Certifiers throughout New Zealand were canvassed during a national series of LVV Certifier training sessions in 2011. From this, a clear consensus emerged that maximum limits should be set.

Early in 2012 the LVVTA Technical Team canvassed several experts and specialists from within the tarmac rally and motor-racing scenes, and collated this information, based on sound technical reasoning and first-hand experience. Wheel alignment data was compared from various manufacturers' specifications, to ensure that these limits were not excessively restrictive.

Even amongst these experts however, opinions varied greatly, as did the factory alignment specifications for different makes and models. It quickly became apparent that a 'one size fits all' limit would be difficult, and so after some consideration, a basic formula of 'manufacturer's specifications plus half a degree' has been agreed on. This may be changed in the future as feedback is received from LVV Certifiers and other experts, but for now we at least have a line in the sand.

Agreed negative camber maximum limits:

The resulting negative camber maximum limit that has been adopted is as follows:

A front or rear suspension system in a low volume vehicle must incorporate no more than half a degree (0 degrees 30mins/0°30') more negative camber than that specified by the vehicle manufacturer.

In any case where a vehicle's camber exceeds that recommended by the vehicle's manufacturer, the LVV Certifier must ensure that the requirements contained in *2.2(2)(a), 2.3(8)*, and *2.4(1)* (referred to earlier in this LVVTA Information Sheet) of the LVVTA suspension standard have been met. The LVV Certifier must also take extra care in ensuring that the vehicle is safe and fit for purpose, based upon the following factors:

- tyre width – the effects of added negative camber are more pronounced when wide, low-profile tyres are fitted; and
- road and brake performance test results; and
- the vehicle manufacturer's wheel alignment specifications.

Verification and documentation:

In order to determine that the suspension geometry is within the limits specified above, an LVV Certifier must obtain a copy of a wheel alignment report which records the identity of the vehicle being inspected, and which has been carried out within 14 days of the LVV certification inspection date. A copy of this

report must accompany the certification application when it is forwarded to the LVVTA office for processing.

Motorsport exclusions:

Any comparison to circuit racing is irrelevant in the case of a road-driven vehicle, due to the aggressive use within a race-track environment. With the additional grip available in a race track situation, coupled with a highly tuned suspension set-up and race tyres, a full tyre contact patch can continue to be achieved during cornering. This doesn't happen during road use, especially with normal road tyres, and therefore any parallels drawn between race cars and road cars cannot be used as a justification for excessive camber adjustment on a road-going vehicle.

An LVV Certifier may however allow a (road-legal) legitimate motor-sport vehicle, owned by a bona fide motor-sport enthusiast, to exceed the limits provided in this LVVTA Information Sheet, on the basis of *exclusion 3.1* of the LVV Suspension Systems Standard, as shown below.

"Low volume vehicles, which are primarily designed and used for LVVTA-recognised motor-sporting events, are not required to comply with 2.3(8)."

The LVV Certifier is required to sight and take a copy of the owner's valid LVV Authority Card and provide this with the LVV certification application.

Examples & means of establishing limits:

Some examples of some modified vehicle types that commonly incorporate a lot of negative camber into their suspension systems are provided below, which will assist vehicle owners and LVV Certifiers to determine how to establish the maximum allowable amount of negative camber for a given vehicle.

Basic explanation of degrees and minutes:

In a full circle there are 360 degrees (°). Each degree is split up into 60 parts, each part being 1/60 of a degree. These parts are called minutes (').

Use of the table:

The table below shows how to work out the maximum permissible camber angle. The reference to 'OE spec' within the table is the vehicle manufacturer's optimum setting. A vehicle manufacturer however, will always specify an allowable tolerance, which is shown in the table as 'Tolerance'. These two values are added together, to give the 'OE spec plus tolerance'. One half degree (-0°30') is then added to this figure as an additional LVV tolerance (shown in table as 'Plus ½°'), with the final column in the table ('Total') providing the maximum permissible negative camber.

Common vehicle models & determining maximum camber limits						
		OE spec	**Tolerance**	**OE Spec plus tolerance**	**Plus ½°**	**Total**
BMW '90-'00 E36 318i	F	-0°30'	0°30'	-0°30' + -0°30' = -1°00'	-0°30'	-1°30'
	R	-2°00'	0°30'	-2°00' + -0°30' = -2°30'	-0°30'	-3°00'
BMW '96-'03 E39 4&6 cyl	F	-0°13'	0°30'	-0°13' + -0°30' = -0°43'	-0°30'	-1°13'
	R	-2°10'	0°20'	-2°10' + -0°20' = -2°30'	-0°30'	-3°00'
Holden Commodore '01 (FE2)	F	-0°12'	0°18'	-0°12' + -0°18' = -0°30'	-0°30'	-1°00'
	R	-0°03'	0°38'	-0°03' + -0°38' = -0°41'	-0°30'	-1°11'

Honda Civic '92-'95 (DOHC)	F	-0°05'	1°00'	-0°05' + -1°00' = -1°05'	-0°30'	-1°35'
	R	-0°25'	1°00'	-0°25' + -1°00' = -1°25'	-0°30'	-1°55'
Honda Civic '96-00	F	0°00'	1°00'	0°00' + -1°00' = -1°00'	-0°30'	-1°30'
	R	-1°00'	1°00'	-1°00 + -1°00' = -2°00'	-0°30'	-2°30'
Toyota Soarer JZZ31 (Z30)	F	0°00'	0°45'	0°00' + -0°45' = -0°45'	-0°30'	-1°15'
	R	-0°50'	0°45'	-0°50' + -0°45' = -1°35'	-0°30'	-2°05'
Mercedes Benz E Class '09	F	-0°23'	0°22'	-0°23' + -0°22' = -0°45'	-0°30'	-1°15'
	R	-1°03'	0°30'	-1°03' + -0°30' = -1°33'	-0°30'	-2°03'
Nissan Silvia/180SX S14	F	-0°50'	0°45'	-0°50' + -0°45' = -1°35'	-0°30'	-2°05'
	R	-1°06'	0°30'	-1°06' + -0°30' = -1°36'	-0°30'	-2°06'
Nissan Skyline R32 (GTR-V)	F	-0°55'	0°45'	-0°55' + -0°45' = -1°40'	-0°30'	-2°10'
	R	-1°05'	0°30'	-1°05' + -0°30' = -1°35'	-0°30'	-2°05'

For any further information or clarification on this LVVTA Information Sheet please contact one of the Technical Team at the LVVTA office.

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