RADICAL SPORTSCARS
HANDLING GUIDE

24 Ivatt Way Business Park,
Westwood,
Peterborough,
PE3 7PG,
United Kingdom

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INTRODUCTION

Below is a guide only.

Engineering a car to perform at its optimum at any given race track takes a lot of consideration. Every change you make will in turn have a negative effect elsewhere on the track. The key is to assess which handling weaknesses are going to gain you the most in laptime, without sacrificing in other areas.

Another key consideration is to make sure that the information you are basing your changes on is solid. Ensure your driver is very clear when describing any handling weakness'. On top of this, use data to verify reports from your driver and to identify which areas are losing the most laptime and focus on these areas.

HANDLING & SETUP GUIDE

For ALL handling issues the first and most important thing to check is TYRES:

- ***Pressure***
- ***Condition***
- ***Temperature***

Pressure for Dunlop tyres, should be in the range of 28psi to 30psi hot, the working temperature is minimum 70°c and ideally around 90°c. Temperature spreads, across the tyre tread ***must not exceed*** 15°c on the front tyres and 10°c on the rear tyres. Over 110°c and the tyre is beginning to overheat. Tyre condition can be more complicated; if you know that the tyres have a lot of miles or have had many heat cycles then, before anything else, try another set. In an ideal world, setup changes should be judged on a new set of tyres, if new tyres are not available then a set that have covered less than 100km are acceptable.

Also look at the tyres for:

- ***Graining or heavy wear***
- ***Unusual colouring***
- ***Is there a lot of 'pickup'?***

All these are a good indicator of what is causing problems.

The next priority is to talk with the driver and make a circuit map, if possible, with information on each part of every corner. You can then decide if the problem is slow, medium or fast corners or everywhere, and if it is entry, mid corner, or exit. There are always various options to rectify any handling issue and all will have a downside, but we have to try and chose the best for each corner bearing in mind which the most important corners are, and which problems are caused by the nature of the circuit.

It is important to understand the difference between understeer and oversteer:

Understeer is when the front tyres have insufficient grip to make the car turn so more steering lock is applied.

Oversteer is the rear tyres not having enough grip.

A race car will always have a balance that tends to either understeer or oversteer. The aim is to have whichever characteristic the driver is more comfortable with, and only an acceptable level of either.

If you have entry and mid-corner understeer, you will probably get exit oversteer, as you will have applied too much lock and then when the 'G-force' and speed have dropped and you start to apply power it will make the car snap to oversteer, and this is what the driver remembers so if you try to cure the oversteer it will probably get worse.

This is why it is very important to ask the driver a lot of questions before deciding what to do.

SOME EXAMPLES OF DRIVER FEEDBACK

Driver Feedback	***Reasons and action to fix***	***Possible Negative effect of fix***
"Slow speed entry understeer"	A common cause for this is the car not running enough rake. It could also be too little front rebound.	Too much rake will cause the rear end to feel less stable under braking.
"Slow speed entry oversteer"	If braking from high speed to a slow corner the problem is probably caused by the car pitching too much, so more rear toe in or lowering the rear ride height will help.	Adding rear toe will increase drag on the straights, increase tyre wear and possibly lose some straight line speed. Lowering the rear ride height may induce understeer.
	Increasing the rear rebound, if it is entering from medium or low-speed then softer rear 'Nik-link' *or* maybe springs.	Softening the rear Nik-link or springs will lose high speed front end grip.
	Reducing rear camber will increase rear grip at slow-speed, so check the rear tyre temperature spreads.	Less rear camber will reduce rear end grip in high speed corners.
"Slow speed exit oversteer"	Sometimes caused by entry understeer. Worth consulting data and video to verify the drivers feedback. If the handling issue is not driver induced, it may be worth reducing the amount of rear camber to aid traction.	A reduction in rear camber can have a negative effect on high speed stability.
"Slow speed exit understeer"	This can often be caused by the drivers inputs. i.e too slow entry speed, results in initial throttle pickup too early. However, if it is not being caused by driver technique a good fix is to try a stiffer rear Roll Bar or Stiffer rear springs.	A stiffer rear roll bar or stiffer rear springs will reduce low speed traction.
"High speed oversteer"	Not enough rear end downforce, or too much front end downforce. Modify front or rear downforce levels to suit.	Adding rear wing will reduce straight line speed. Possibly look at removing front end downforce if there are few high speed corners

STIFFER FRONT ANTI-ROLL BAR

A stiffer front ARB will give an improved turn in response. More load transfer = more grip. Less body roll = keeps tyre footprint flatter. In terms of balance, it will give more rear traction.

Potential negative of a stiffer front ARB is mid corner understeer, and possible slight exit understeer.

STIFFER REAR ANTI-ROLL BAR

A stiffer rear ARB will give mid corner oversteer in high speed areas.

A negative effect will be reduced traction, especially in low speed areas. It also gives increased rear tyre wear.

STIFFER FRONT SPRING

A stiffer front spring will give more stability from the front end. Less dive under braking giving more consistency over smooth surfaces. Improved front end grip in high speed areas due to better control of aerodynamic forces.

Less feel from car. Less grip on bumpy surfaces, and less grip in low loaded areas.

STIFFER REAR SPRING

A Stiffer rear spring will give more stability from the rear end. Flatter cornering = better tyre footprint = more rear end grip in high speed areas. Due to the fact that the car will squat less under acceleration, this can improve mid corner to exit understeer.

A negative effect is that the driver will have less feel from car. The car will also have less grip on bumpy surfaces, and less traction in low speed areas.

INCREASE CAMBER

An increase in camber will give more tyre bite. This results in better grip whilst cornering, especially in high speed areas. When considering a camber change it is important to keep a close eye of temperature spreads and tyre wear. The temperature spread across a tyre should be between 10 and 15°C hotter on the inside of the tyre to the outside.

Less tyre footprint in low loaded areas, under braking and acceleration = less grip and more tyre wear.

HIGHER TYRE PRESSURE

A higher tyre pressure can be advantageous as it will provide more stability from the tyre sidewall, meaning better footprint. This can also mean you need to run less camber for same grip levels.

However, if the tyre pressure is too high you will lose grip all round, and increase tyre wear.

The tyre manufacturer will be able to advise on an optimum tyre pressure. It is very important to adhere to any guidelines set out by the tyre manufacturer.

FRONT TOE IN/OUT

Positives:

- Toe in = more stability in a straight line, and better over bumpy surfaces.
- Toe out = Better initial turn in.

Negatives:

- Toe in = Loss of responsiveness and feel from front end.
- Toe out = Over responsiveness from front end. Could upset the rear on turn in.
- Too much of either will increase drag and lose straight line speed, and increase tyre temperatures.

REAR TOE IN/OUT

Positives:

- Toe in = more stability and better traction.
- Toe out = rear wheel steer effect.

Negatives

- Toe in = more drag and increased tyre temps.
- Toe out = Unstable rear end feeling, especially under braking and in high load areas.

FRONT RIDE HEIGHT

In general, you want to run the front diffusor as low as is allowed in the regulations. The only exception to this is at very bumpy circuits to avoid excessive wear. The effect of lower front ride height is an increase in mechanical front end grip. It also increases the effectiveness of front aerodynamics, increasing grip all round.

REAR RIDE HEIGHT

Lowering rear ride height will increase rear end mechanical grip in lower speed corners.

A negative effect of lowering the rear is that it reduces the amount of rake, which gives less overall downforce. Generally, the lower the car is the more efficient it becomes. Below a certain point the rear diffuser will stall losing overall downforce.

WINGS/DIVE PLANES

Adding more wing angle or diveplanes will give more aerodynamic grip. The trade-off here is ensuring that the gains made in cornering speed outweigh the inevitable losses in straight line speed.

FRONT BUMP DAMPING (SOMETIMES KNOWN AS COMPRESSION DAMPING)

Adding front bump damping will give less ‘dive’ under braking. It will also give a quicker change of direction response as it will load tyre more.

A negative effect is that it makes the car less stable over bumps and kerbs. It can also cause some mid corner understeer, especially in high loaded areas.

REAR BUMP DAMPING (SOMETIMES KNOWN AS COMPRESSION DAMPING)

Adding rear bump damping will mean that the car will squat less under acceleration. This results in a quicker change of direction response.

A negative effect is that it makes the car less stable over bumps and kerbs. It can also cause some snap oversteer.

FRONT REBOUND DAMPING

Adding front rebound damping will hold the front end of the car down. This is quite commonly used to try and eliminate understeer as it keeps more weight on the front axle initially.

REAR REBOUND DAMPING

Adding rear rebound damping will hold the rear end of the car down when forces are expecting the rear to raise, under hard braking for example.

A negative effect is a reduction in traction, especially in low speed areas.

INCREASE FRONT PRELOAD

An increase in front spring preload will hold the front of car up at higher speeds, meaning you can run a lower front ride height, and avoid grounding the splitter. It will also give an increase in traction and less dive under braking.

It may cause initial turn in understeer and less grip over bumpy surfaces.

- All of the above are only applicable in certain working areas. Going too far one way or the other may have adverse effects that are not noted.
- All of the changes and effects can be considered to do the opposite when reversed

HANDLING ISSUES AND POTENTIAL SOLUTIONS

- ***With all medium to high speed entry and mid-corner problems***, you should first try to solve with an increase or decrease in front or rear downforce. This can be achieved with dive planes and rear wing flap or with ride-height adjustment. In general, a lower ride height gives more downforce, and will also increase mechanical grip.

- ***If downforce or ride height is not the answer***, then try an increase in camber to increase high-speed grip, but this in-turn will decrease slow-speed grip.

  For example: ***If you have high-speed mid-corner oversteer***, then increasing the camber should help, but it will decrease traction out of slow corners.

- ***Corner exit problems at all speeds*** are generally a result of what has happened in the mid-corner. However, out of slow-speed corners, traction can be improved by reducing rear camber (as

above) or softening the rear 'Nik-link' or springs. Reducing rear compression damping, can help as well.

If you make the opposite change to the front of the car it will also have a similar effect.

In fast corners going stiffer with springs and maybe bars will generally increase grip.

- ***Increasing 'toe-out' at front and 'toe-in' at the rear*** will increase stability and tyre temps. Increasing spring rates and tyre pressure will also increase tyre temperatures and tyre wear.
- ***Damping*** has many functions, but primarily it is used to keep the tyre in contact with the track by controlling the spring and chassis movement frequencies, so in general you want to keep the springs and dampers as soft as possible, but stiff enough to control the roll and pitch of the car. Then, the balance is controlled by the roll and spring rate differences front to rear and aero levels.
- The adjustments on the dampers are called low or high-speed compression and rebound. Low or high speed refers to damper piston speed, not car speed.

For example; on entry to a high-speed corner, the lateral load transfer is relatively slow as you gradually apply more lock, so the damper movement is slow. Whereas if you go over a kerb at any speed the damper movement is fast, braking and turn-in to a slow corner is much more aggressive than in a fast corner, therefore the damper movement is faster, but usually not as fast as over kerbs.

- ***The damping force increases with the speed of the piston***:

If you make the high-speed adjustment too stiff, the damper will not move fast enough and the car will bounce rather than ride the kerb.

If you have the low-speed adjustment too soft, the car will not respond to driver inputs quick enough in the corners.

Increasing rebound is a good way to increase grip, but it will also increase ride 'harshness', which can make the car skip across the track. There are no simple answers, but damping adjustments are quick to do in the pit lane and will give you more information to help resolve the issues later.