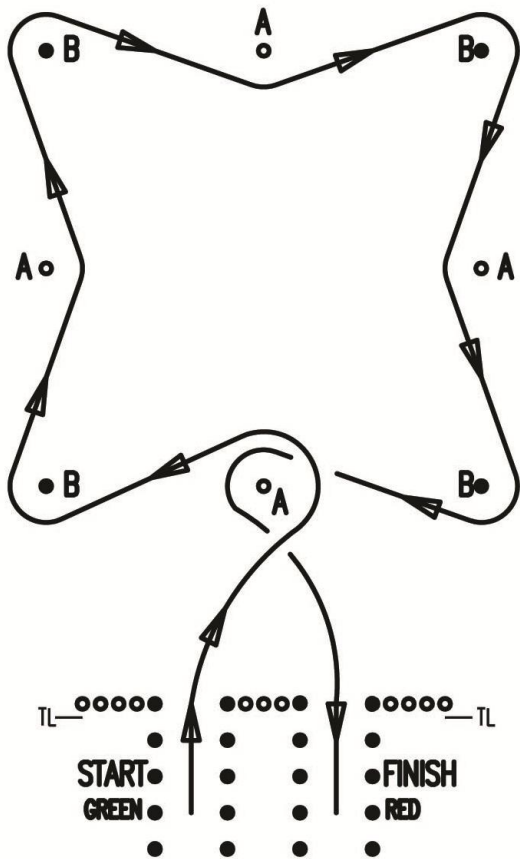


## Some Hints for the Motorkhana Newcomer

### Getting around those pesky markers.

Some of the Motorkhana courses seem to be way too difficult and many find that they round one marker only to find the next marker impossible to get around. This predicament happens when there is more than one change of direction and the markers are close together.



A seemingly easy test is the Square Slalom; on paper it looks easy, not a complicated course around the markers, so it should be easy....wrong!! It is a test where many drivers get frustrated.

There are two ways of driving this test. The first is to execute a handbrake turn at each sharp turn. Looking at the diagram those sharp turns are around the 1st, 2nd, 4th, 6th, 8th and 9th markers.

To carry out a handbrake turn successfully and efficiently takes practice, but don't get disheartened, there is another way.

The other way is to drive around each marker carefully in a way that lines you up for the subsequent markers in the rest of the course.

Always study the test diagram closely. Identify which are the tight turns and work out a driving line that opens up these turns so that the exit line puts you in an optimum position to drive around the next marker.

Don't be tempted to drive too fast; most cars will understeer (see explanation below) and the faster you take a corner, the worse the understeer becomes.

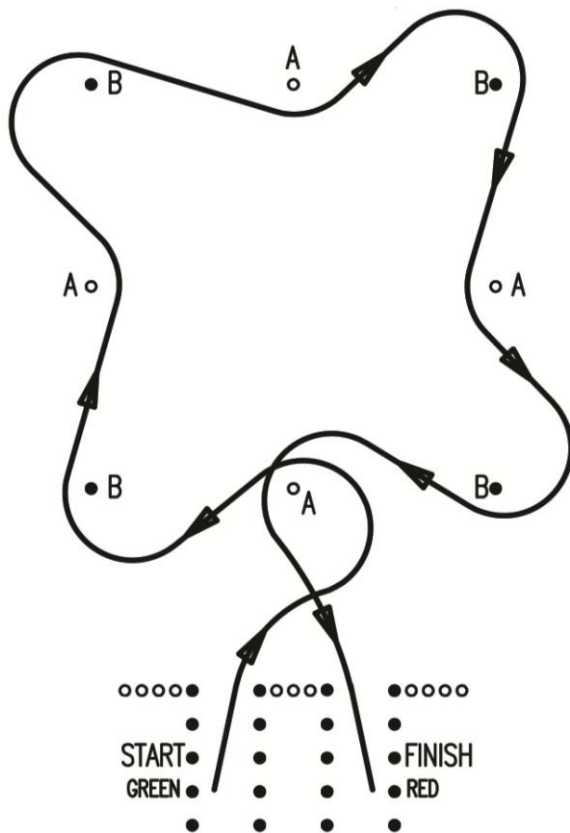
Try to "straight line" other sections of the test as much as possible; this is where to pick up some speed.

The next diagram shows the same Square Slalom test, but with a suggested driving line to allow you to complete the test efficiently and without the need to handbrake turn.

Remember that the start garage is quite wide, even for the largest of vehicles, so take advantage of all the space and line up so that you can take your chosen line around the first marker. In the case of the square slalom example, your vehicle should be angled to the right as much as possible.

You'll notice that the first marker is taken very wide with an exit line allowing a wide entry to the turn around the second marker. This is the trickiest part of the test and there is a temptation to take it too fast. Remember the dreaded understeer, so take it easy on the accelerator.

There will also be a lot of steering wheel action going from full-lock left to full-lock right in a very short period of time; drive at a speed that gives you time to carry out this manoeuvre between the markers.



A wide entry to marker 2 allows you to take a straighter and faster line past marker 3.

Marker 4 is also taken with a wide entry giving as much of a straight line past 5th marker as possible.

The rest of the test is a duplication of those types of turns or passes. Remember that after the relatively fast sections, slow down sufficiently to take the tight corners without inducing understeer.

The above diagram was drawn using the turning circle, width and front and rear overhang of a VE Commodore into consideration; as you can see, driving an efficient line makes any test possible, even in the biggest of cars.

It might feel slow driving a test in this way; it's certainly not as spectacular as handbraking, but you'd be surprised at how close your times will be to the other more experienced drivers.

## **A bit more confidence**

Once you get the knack of taking lines which get you around the course as efficiently as possible, you can look at some things to improve your times.

Where possible, always take a wide entry to a flag and make sure your exit to the turn allows for a good line around the next marker. If there is sequence of markers, try to make to first turn (just after starting the test) the widest so it allows you to take a faster line around the next markers.

In forward tests, use first gear in a manual. Most modern cars will be so highly geared that it will be unnecessary to change into 2nd gear. 1st gear will give the best acceleration and control.

Too much sideways motoring is usually a recipe for slow times and smashed flags. It's fun to hold the car in a rear end slide for a while, but while the tail of the car is going sideways, you probably aren't accelerating (just wearing out tyres). Look at how straight World Rally Champion Sebastian Loeb comes off the turns in his World Rally Car.

As in any sport, get plenty of practice or compete often. Try to learn from your mistakes. Watch the best drivers to see what they do differently and ask them for advice.

## Improving the Car

Assuming you are driving a more or less standard road car. You don't need to modify it to motorkhana but there are a few little things you can do to it to make life easier.

- Fold in the external mirrors so they won't knock flags
- If there are reversing tests and the seats' headrests come off easily, remove them.
- If you've progressed to doing hand-brake turns, make sure the handbrake works well. It must easily lock the rear wheels on bitumen at about 30kmh (check when no-one is driving behind you!). If it won't lock both, read the later section – "Fixing the Handbrake"
- Disable the handbrake ratchet by taping the button in or inserting a pin in the mechanism and securing it
- Get some old wheels and tyres so you don't wear out your good tyres. Replace the driven wheels or all four.
- Try different tyre pressures. For example, lower the pressure on a FWD's front tyres and raise the pressure on the rear. Ask around the pits to see what the experienced drivers do.
- Don't carry unnecessary weight. Arrive at the event with about 10 litres of fuel in the tank. Take out the spare tyre and jack, any tools, etc. - it all slows you down.

As you get keener, there are a few other things which might help. But note that in the early stages, you can save much more time by improving the driver than by modifying the car!

- Improve the engine performance, but not too much. You need smooth instant response from low revs to accelerate out of turns and after changes from 1st to reverse and vice versa. A few more bhp or kW at high revs won't deliver much, if any, improvement in your times.
- Buy some decent tyres; formula R types are best. They'll be safer on the road too
- Stiffer suspension - better shocks, stiffer springs, stiffer sway bars, etc. - will help reduce body roll if done moderately, but don't go too far. A very stiff car will be twitchy and have poor traction on uneven surfaces. Lowered suspension will also help, especially when the venue surface is smooth.
- Fit a limited slip differential (LSD). In a front drive car, this will have to be set to a low torque or the car will be nasty to drive. The torque biasing types (such as Quaife's ATB) are the best.  
In a RWD car, a welded diff (planet gears welded to the carrier) is a cheap way to get the right effect, but causes tyre scrubbing on the road, so a limited slip diff or a locking diff is preferable.
- Some modern cars will fight you if you attempt a handbrake turn or front throw. Traction control, stability control, ABS, etc. can get confused and make the car do funny things. Some people have been known to pull a few

fuses to disable these features but the car's computer might respond by shutting down or severely slowing the car. Try one of these before you buy.

- Front wheel drive (FWD) is generally more successful than rear (RWD) but the addition of a Limited Slip Diff (LSD) or a locked or locking diff will even things up a lot.
- Small is better. If the classes are based on wheelbase, choose a car with short overhangs and not too high or wide. A Ferrari Enzo at 2 metres wide is a handful on a tight slalom.
- You want a torquey, responsive engine which will do at least 50kmh in 1st or reverse. If it does over 70 in 1st or reverse, it may be too sluggish out of slow turns. A "cammy" engine with weak low speed response makes motorkhana much more difficult.
- It should be easy to change from 1st to reverse and back. With gearlevers with collars you have to lift, you could simply tape the collar in the up position.

## How to Handbrake-Turn

A handbrake turn is used to induce oversteer (see explanation below)

### In a front drive car:

1. approach a flag in first gear, about a car's width to the side of it, if there is space
2. use the foot brake to slow down to a speed that you would normally take the marker at a 45 degree turn. Brake as hard as you can without losing front wheel grip; this transfers the weight of the vehicle to the front leaving the rear light
3. at the same time as braking turn towards the flag as if to drive past it with a small clearance
4. pull the handbrake on just before you reach the flag
5. the rear of the car should slide
6. straighten the front wheels to point where you want to go and accelerate, even if the back is still sliding
7. If the rear slide is excessive, apply opposite lock i.e. steer away from the flag you are rounding.

NOTE: You normally don't need to worry about the clutch, keep drive to the front wheels during the turn.

### In a rear drive car:

1. approach a flag in first gear, almost a car's width to the side of it if there is space
2. Use the foot brake to slow down to a speed that you would normally take the marker at a 45 degree turn. Brake as hard as you can without losing front wheel grip; this transfers the weight of the vehicle to the front leaving the rear light
3. staying off the accelerator, turn towards the flag as if to drive past it with a small clearance
4. depress the clutch pedal and pull the handbrake on just before you reach the flag
5. the rear of the car should start to slide
6. increase engine revs and raise the clutch pedal
7. the back of the car should continue sliding under power
8. point the front wheels where you want to go and accelerate, trying to minimize wheel spin
9. If the rear slide is excessive, apply opposite lock i.e. Steer away from the flag you are rounding. You might need to do this very soon after raising the clutch pedal, especially if you have a limited slip or locked differential

## Optimising the handbrake mechanism

### If the rear brakes are discs:

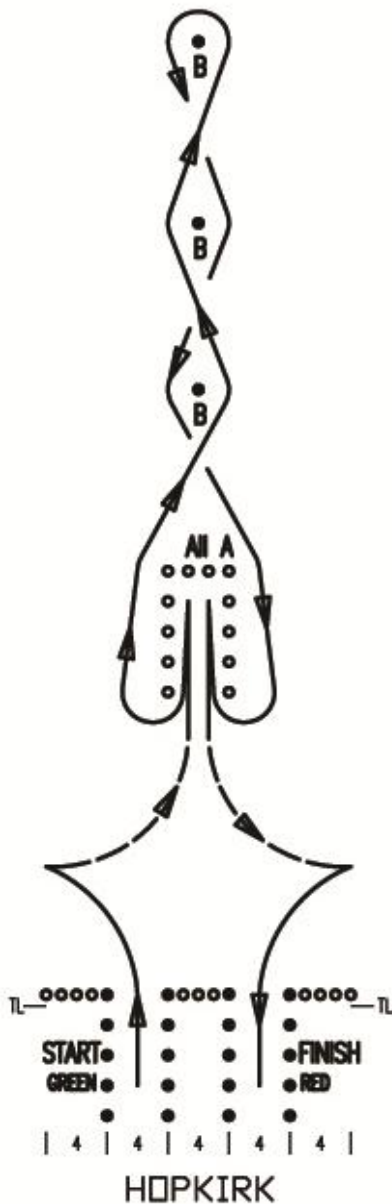
- Replace or repair any worn parts including rotors, pads, levers, etc.
- deglaze the rotors and pads being careful not to re-profile the pads
- adjust the cables, making them even so both wheels lock
- Lubricate any levers or pivots (but not the rotors or pads!)
- new pads work better than old ones, once bedded in
- a few brake specialists can supply softer, grippier pad material - but it wears faster
- If it still won't work well, consider fitting a hydraulic handbrake from a rally shop or making one yourself using a remote reservoir type master cylinder. This also allows you to put the lever in a more convenient position near the steering wheel. In a registered road car, keep the standard one as well to satisfy the parking brake legal requirements

### If the rear brakes are drums:

- Replace or repair any worn parts including drums, pads, levers, backing plates, etc.
- deglaze the drums and linings being careful not to re-profile the linings
- adjust the cables, making them even so both wheels lock
- Lubricate any levers or pivots (but not the drums or linings!)
- new linings work better than old ones, once bedded in
- a few brake specialists can supply softer, grippier lining material - but it wears faster
- a common mod on Minis is to lengthen the levers which project through the backing plates
- If it still won't work well, consider fitting a hydraulic handbrake from a rally shop or making one yourself using a remote reservoir type master cylinder. This also allows you to put the lever in a more convenient position near the steering wheel. In a registered road car, keep the standard one as well to satisfy the parking brake legal requirements

Generally speaking, a mechanical handbrake will work better with the hand lever as low as possible with no slack in the cables, as you will be able to pull harder with a straighter arm. But some work better with some slack in the cables.

## How to do a Rear Throw



A rear throw such as the first turn on the Hopkirk and Paddy tests is a handbrake turn combined with a gearchange from first to reverse. For those tests, aim straight at a spot about 4 or 5 metres to the left of the centre of the space I want to reverse into. Different cars and surfaces will require a different aim point.

Accelerate straight and hard for about 10 metres and then do a handbrake turn to the right. Once the rear is sliding around, change into reverse gear and try to reverse before the rear finishes sliding. Done right, you will accelerate into the field garage in reverse without the car having stopped.

The above generally applies to all FWD cars; with RWD cars the principles are very similar.

## How to do a Front Throw

A front throw such as the final turn on the Hopkirk and Paddy tests is the opposite of a rear throw. In a FWD car, it involves reversing reasonably fast and making the front of the car slide, pivoting about the rear.

The final part of the manoeuvre is to select 1st gear and drive off in the opposite direction.

Taking the Hopkirk test as an example, aim at a spot about 3 or 4 metres to the right of the centre of the space I want to drive forward into. Different cars and

surfaces will require a different aim point.

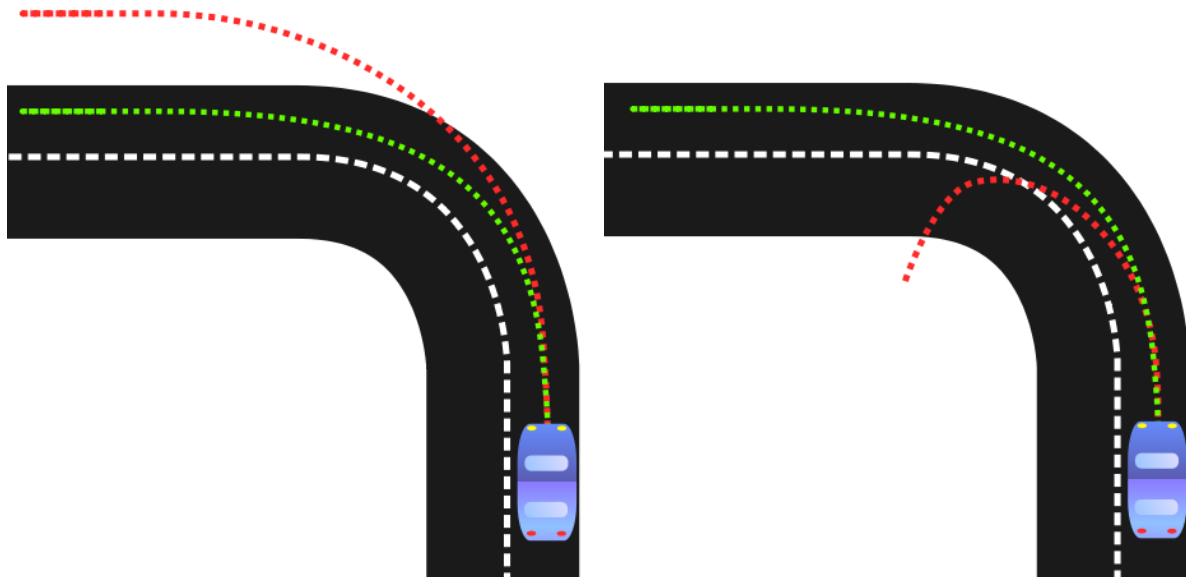
Accelerate hard for over 10 metres and swing the steering wheel to the right. Accelerate in reverse during the start of the turn and give the front brakes a jab to help the front to break loose (but many good drivers don't touch the brakes). Once the front is sliding around, change into first gear and try to drive forward before the front finishes sliding. Done right, this will leave me accelerating into the finish garage in first gear without the car having stopped.

The above generally applies to all FWD cars. With RWD cars don't accelerate in reverse during the start of the turn, use the foot brake to induce a slide.



## Explanation of Understeer and Oversteer

Understeer and oversteer are vehicle dynamics terms used to describe the sensitivity of a vehicle to steering.



Understeer: the car does not turn enough and leaves the road.

Oversteer: the car turns more sharply than intended and could get into a spin.

Simply put, oversteer is what occurs when a car turns (steers) by more than (over) the amount commanded by the driver. Conversely, understeer is what occurs when a car steers less than, or 'under' the amount commanded by the driver.

Automotive engineers define understeer and oversteer based on changes in steering angle associated with changes in lateral acceleration over a sequence of steady-state circular turning tests. Car and motorsport enthusiasts often use the terminology more generally in magazines and blogs to describe vehicle response to steering in all kinds of manoeuvres.

This guide has used some text and drawings from Mototorkhana Victoria's website and Wikipedia.