ON THE RIGHT LINES

This guide to circuit-specific techniques will be useful if you're taking your Porsche to a track for the first time, though the underlying skills can be applied to elements of road driving, too...

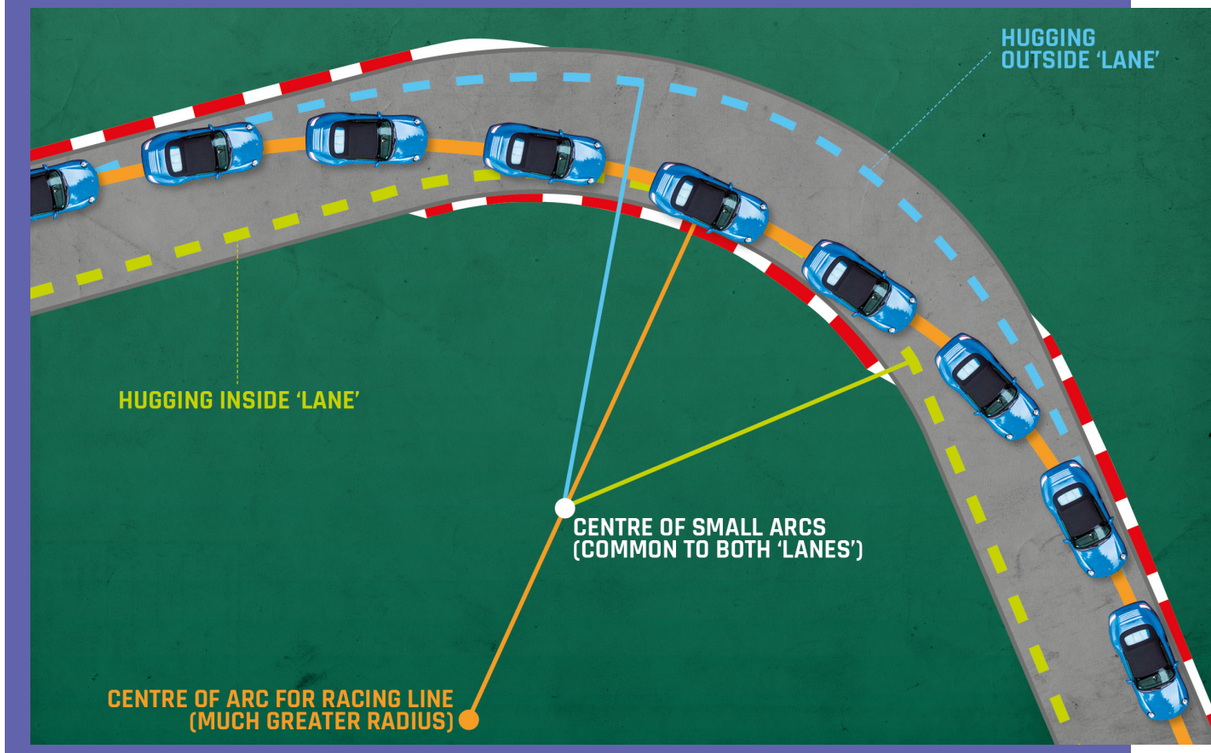
Although not directly intuitive, it's likely you've heard the phrase 'racing line'. In case you haven't, the term refers to the path followed for the quickest lap of a circuit, far from a simple straight line. You may well scribe a true straight line between corners, but you'll need plenty of arcs in the bends — these are the bits that make the most difference to your lap time. From this point onward, I'll refer to your *line* through a corner. By this, I mean your trajectory through a given bend. But why the precision of a specific line? Essentially, the racer is looking for a path of least resistance – the quickest way from start to finish. Corners, both numerous and ranging in complexity provide a challenge – the need to lose and regain speed in order to change direction. Essentially, the goal of circuit driving is to minimise lost speed and maximise the average speed across the lap. Easy, it is not.

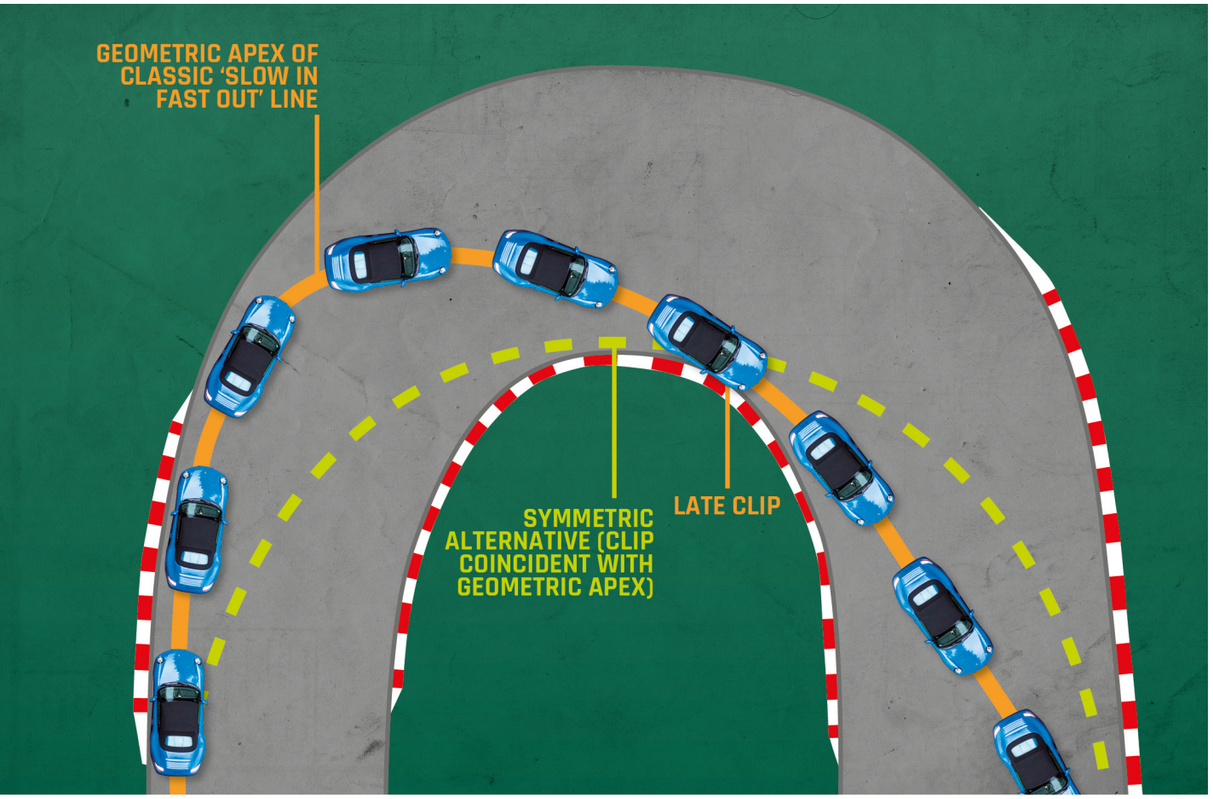
Often, during an on-track driving session, when I'm coaching somebody new, they'll ask me to show them the *best* line for the given circuit. Rather than give one line to copy, I prefer to start with more generic concepts. By applying these to the track and helping the driver develop their *own* lines as they learn, they'll find it much easier to apply their new knowledge to any other circuit. Teach a man to fish, and all that! This way, they'll build their own lines much more effectively in the future. Although this may seem like slow progress, let's not forget that understanding *why* a line is good, bad or better is far more useful than simply copying those of others. After all, a change in car or weather conditions may mean your lines need adjustment anyway!

INSIDE OUT

If you watch motorsport or have discussed circuit driving in the past, I expect you've come across terms such as 'the inside', 'the outside' and 'apex' or 'clipping the apex'. Less likely, the 'clipping point'. To carry maximum speed through a simple 90-degree right-hand bend, you're looking to position your car to the very *outside* ahead of the curve. This is the extreme left, immediately adjacent to the grass or kerb stones. At the end of the straight, as you turn into the bend, you're aiming for your car to move gradually to the *inside* of the curve (extreme right) to *clip* the inside edge (kissing the kerb, if present) about midway through the bend. From this point, you can ease the car back to the *outside* of the bend (extreme left) as you join the following straight. At a simple level, this line is the straightest — or largest radius — curve you can scribe through the bend using the full width of the track. It's a significantly larger radius (straighter) than if you hug either the inner edge or outer edge of the track and helps to explain why circuit cornering speeds can be so much higher than within a single lane on the public road. In reality, rarely will a racing line be of constant radius. As you steer into the bend you are reducing radius progressively toward a minimum; from straight to the required maximum curvature. There's a steering transition into the curve. Then, as you unwind the steering, you open the radius back to a straight line. Again, a smooth transition if done well. As you load the steering you should feel it become heavier until you reach a maximum and can *clip* the inner edge. From here, you can start to unwind the steering slowly, the self-centring effect both helping you and reducing in strength as the car straightens up, running wide to use all the space.

If all this isn't completely new, it's likely you have heard the word *apex*. However, despite almost universal modern usage, what people should really say is the *clipping point*. This is the point at which your vehicle clips the inner edge of the track for your chosen arc. Mathematically speaking, the *apex* of the line through a corner relates to the shape of the arc itself and is independent of the track boundaries. In cornering, this translates usually as the point of tightest radius; where you'll have a maximum amount of steering applied. For simple corners – sketched during many a discussion – this *can* coincide with the point at which you clip the inside edge of the track and so may well be the source of the misunderstanding. However, in most cases, the best lines through any given corner will involve a clipping point some distance after where you'll use the most steering lock (both minimum radius and home of the *geometric* apex).

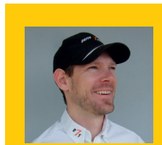




FASHIONABLY LATE

When somebody refers to a 'late apex' (a 180-degree hairpin curve, for example), what they mean is an *early* apex, with a *late* clipping point. The classic beginner's racing line for this type of corner involves driving deeper into the bend, staying to the outside for longer than expected. You brake later, increase the length of the previous straight and drive a slow, tight curve some distance from the inner kerb stones. You create your own corner, a different shape to the track itself. Your tight curve is a short distance travelled with the tyres heavily loaded. You rotate your car through most of the required change in direction in far less time, pointing it up the following straight much earlier. You can unwind the steering early, your exit a much straighter line. Get it right and you can accelerate hard, hitting a late clipping point about two thirds round the inner edge as you beeline for the outside and join the next straight. It's not the very fastest way through the corner, but is a useful demonstration of a technique which can be applied more subtly once you start to learn trail braking (a performance-enhancing alternative to straight-line braking).

This classic line illustrates perfectly the oft-quoted 'slow in, fast out'. With both straights increased in length – joined by the tight radius portion of your line – you relieve cornering stress from the car's tyres early in the bend. This reduces drag *and* improves stability, which allows you to apply much more power early on for strong acceleration down the next straight. By contrast, if you followed a simple symmetric curve using an adaptation of the basic approach from the 90-degree bend described earlier, your apex and clipping point coincide at the inner kerb exactly mid-bend. Your minimum speed can be higher as a result of the greater radius, but this will last much longer. Heavy acceleration can start only when on the next straight. Which line is best will depend on your ability, your car's strengths and the track itself, but a blend of the two is usually where the optimum is found.



DRIVING FORCE

Neil Furber is *GT Porsche's* resident driving expert. With a background as a mechanical engineer in Formula One, he brings a unique technical insight to driver coaching. Splitting his time between the French Alps and the UK, Neil coaches drivers through his brand, Drive 7Tenths (*drive7tenths.com*) and is also a Porsche Driving Consultant at Porsche Experience Centre Silverstone. Have a question about driving? Email him at *enquiries@drive7tenths.com*.

PROS AND CONS

It's easy to assume there's one optimal racing line for a given circuit. In a race, apart from overtaking or wheel-to-wheel battles, you may notice most of the cars following a very similar trajectory. Occasionally, a driver may use a wildly different line through a sequence of bends. They may have found an advantage for themselves or in sacrificing one portion of the track, they gain elsewhere to gain competitive advantage. There are several contributing factors including weather conditions. During a long race, there will be debris and 'marbles' of old rubber swept to the side of a well-used line. The difference in grip from one area to another can be quite pronounced. Optimal wet, or damp, lines can be different to a preferred dry line due to standing water and local grip variation from unworn or highly rubber-coated areas. Trading the minimum number of losses for the maximum gains will achieve the best lap times.

Your car's relative strengths and weaknesses have their role to play also. For a lightweight car with low engine power and strong roadholding (maximum cornering force), maintaining a high constant speed in a large radius curve can prove most effective when considering raw lap time. A very powerful car with weak roadholding may benefit more from the (early apex) late clipping point approach. Despite losing some time on corner entry, a chance to use full engine power with minimal tyre drag can make a significant gain by the end of the next straight.

TECHNIQUE AND ABILITY

As you learn more about racing lines, vehicle dynamics and control, you'll find there's more to it than line alone. For ultimate lap times, you'll need to choose the best approach to each and every corner. Trail braking, throttle-induced car rotation and subtle changes to your steering inputs can help in varying degrees. Certain approaches could achieve theoretical maximum performance. That said, limitations of driver skill, fatigue and inherent vehicle stability can mean partial or total loss of control. Sometimes, on balance, a slightly tempered approach can pay dividends by leaving margin for error, making your Porsche easier to drive. Think walking down a narrow path instead of along a tightrope!

With respect to lines, generally, the more exaggerated, deeper entries of (early apex) late clipping points are best for long, slow corners to get the car rotated ready for strong acceleration. Whereas, faster, more open bends at high speeds are best driven with momentum conservation in mind. A gradual arc of almost constant radius and at consistently high speed tends to work well. In this case your apex and clipping point may coincide. As for the complexities of multiple bends, we'll explore this topic in forthcoming issues of *GT Porsche* — although Dan is moving on from the editor's chair, this series of articles is planned to continue. With this in mind, if you have any specific driver coaching topics you'd like to read about, do get in touch.