

# Racecar 101

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# Outline

1 What makes a car fast?

2 Vehicle Basics

## Note

This first part is a very simplified breakdown

- It's not the most accurate
- It's not to insult anyone's intelligence

It's simply to not distract from the things that can be easily forgotten or muddled.

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To make a car **faster**, you must make the car **accelerate more**

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We care about acceleration, so rearrange:

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The latter two hold **only if the tires can transfer the torque**

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### Smaller/Narrower Tires

Decreases total vehicle mass, but decreases total acceleration potential  
Also reduces unsprung mass (improves vehicle handling and response)

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- Almost always limited by the power unit (ICE, electric motor, rubber band windup, etc.)

## Lateral Acceleration

Turning causes *Lateral Acceleration*, which is not a change in speed, but of direction:

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Therefore given:

- a force,  $F$  (tire traction)
- a mass,  $m$  (the car)
- and a radius,  $r$  (the track/racing line)

there is a **limit to the maximum velocity**

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  - How?

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- Increase the maximum force the tires can exert
- How?
  - Aero downforce
  - Different tires
  - Suspension design, etc....



## Quick Review

Higher Acceleration = Faster Car

	Limited by	How to make better?
Longitudinal Acceleration	Force (Braking and Power)	Bigger Engine/Brakes
	Mass	Reduce it
Lateral Acceleration	Force (Tire Traction)	Increase Grip
	Mass	Reduce it

## G-G Curve

What about lateral and longitudinal acceleration at the same time?

G-G Curve (or Traction Circle)



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## G-G Curve (or Traction Circle)

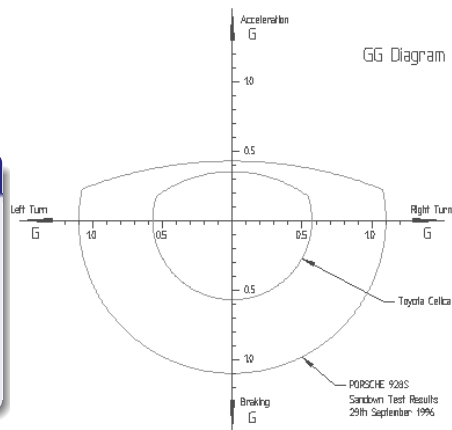


Figure 2

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## G-G Curve (or Traction Circle)

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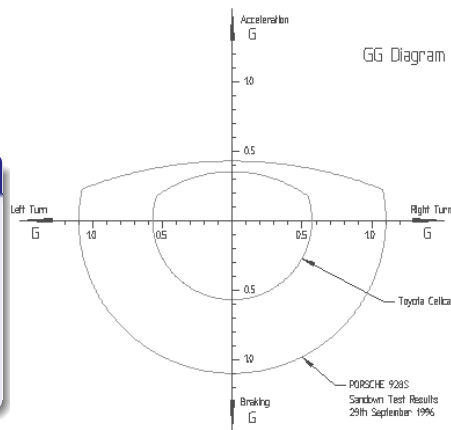


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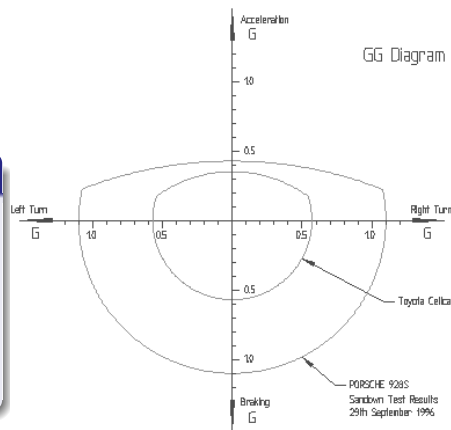


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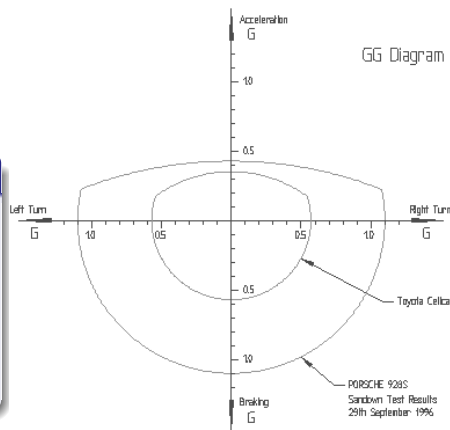


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- On the circle = driving at the edge

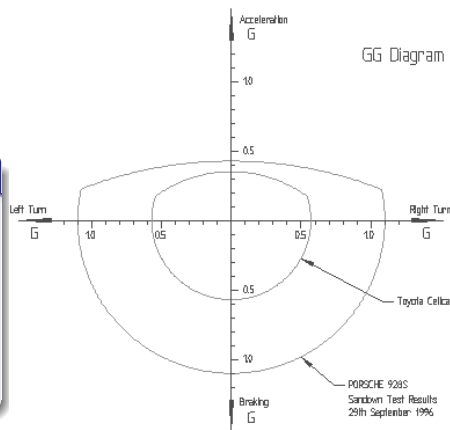


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# G-G Curve: Misc Remarks

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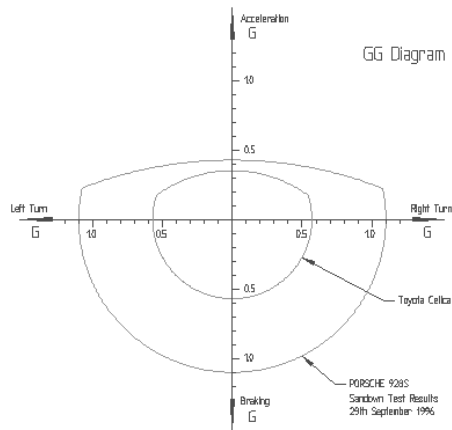


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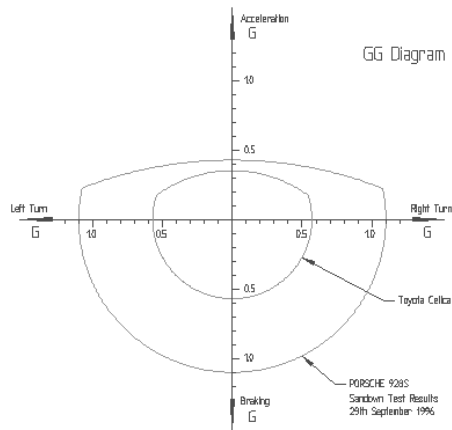


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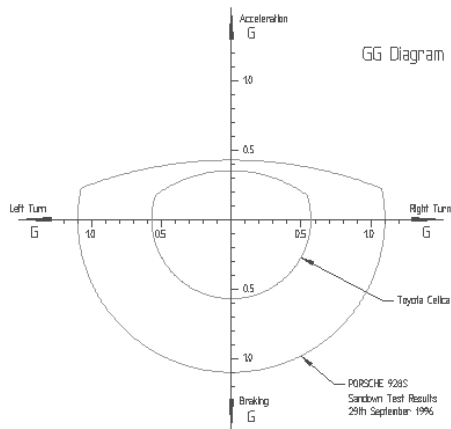


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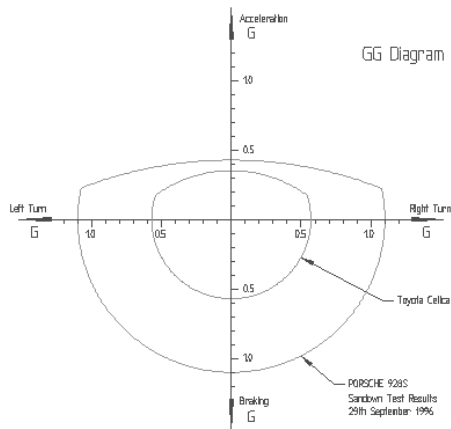


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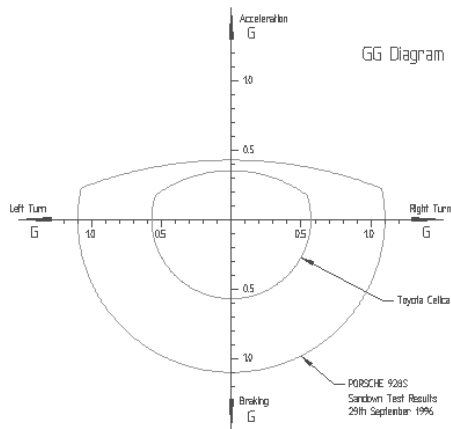


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  - Top part of curve isn't *quite* circular
  - **Positive acceleration is nearly always limited by the power unit, not the tires**
  - For (nearly) all cars, the power unit is the most severe acceleration limitation.

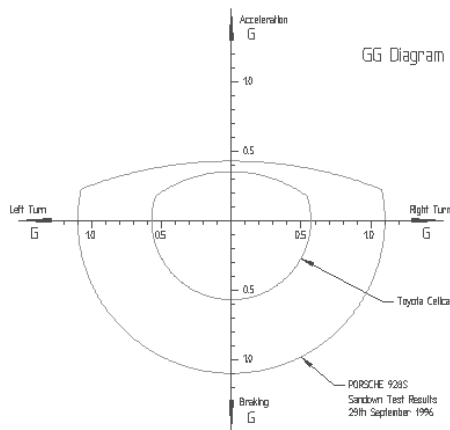


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