# Racecar 101

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# Outline

### 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 muddied.

# What makes a car go fast?

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

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# What famous equation involves acceleration?

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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 vehcile handling and response)

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

# Lateral Acceleration

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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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   - 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

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**G-G Curve (or Traction Circle)**

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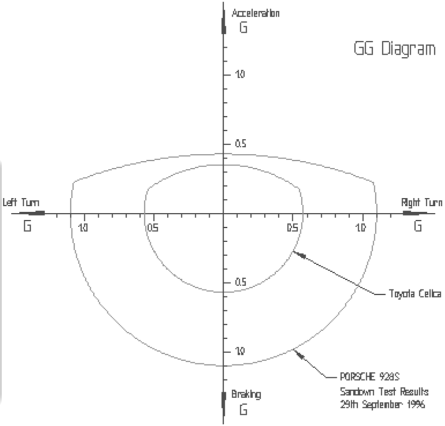


Figure 2

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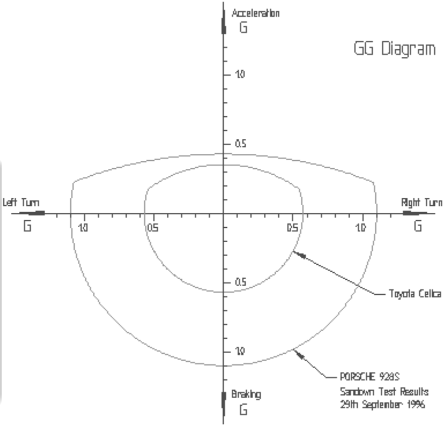


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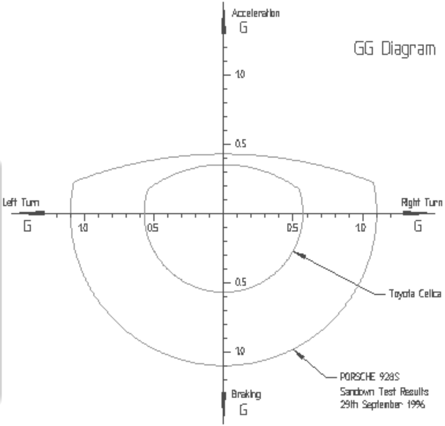


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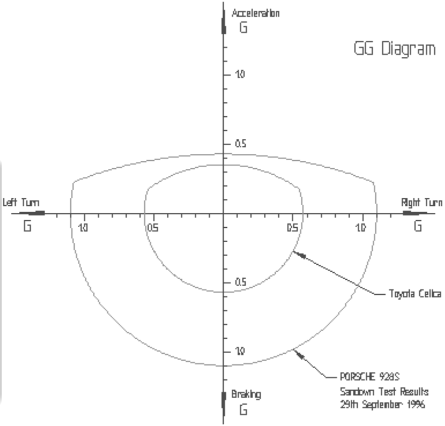


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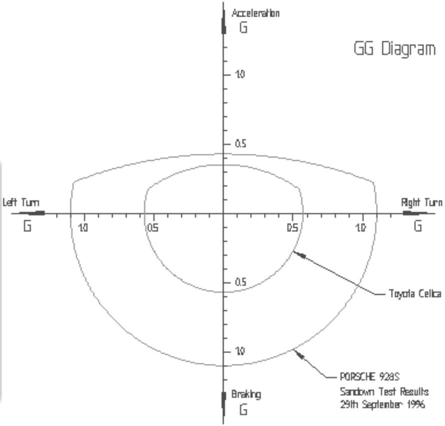


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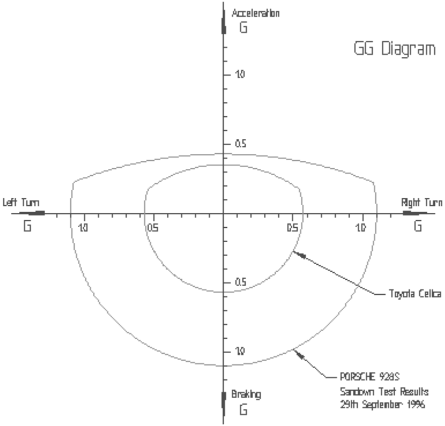


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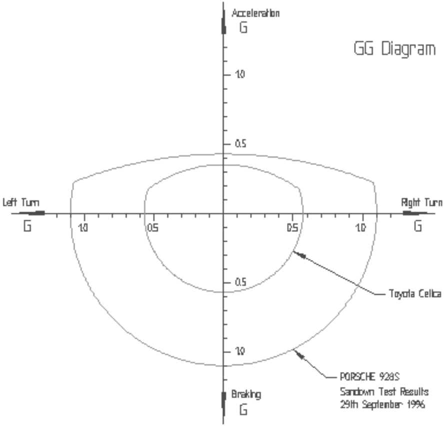


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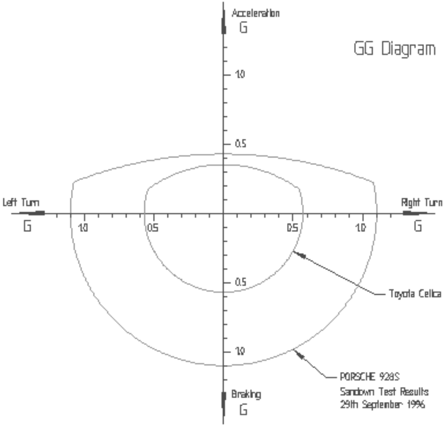


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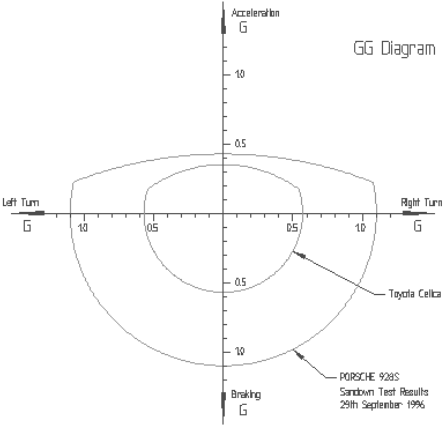


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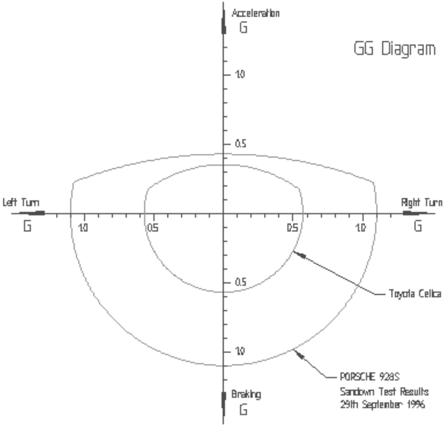


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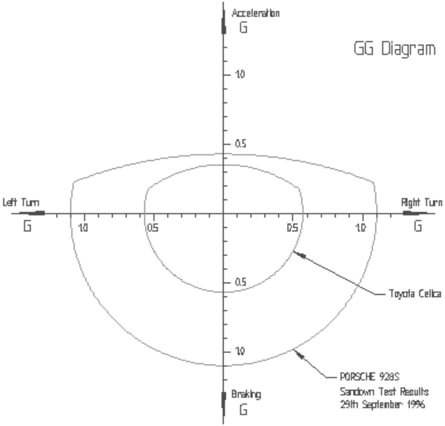
  - **Positive acceleration is nearly always limited by the power unit, not the tires**
  - For (nearly) all cars, the power unit is the most severe acceleration limitation.

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- $\mu$ is generally assumed to be constant
  - So $F$ is linearly dependent on $N$

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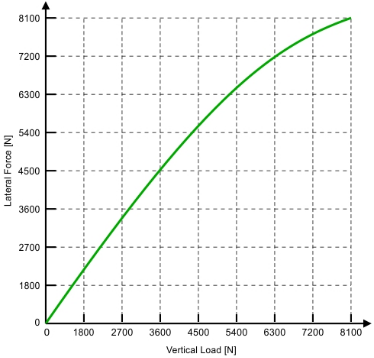

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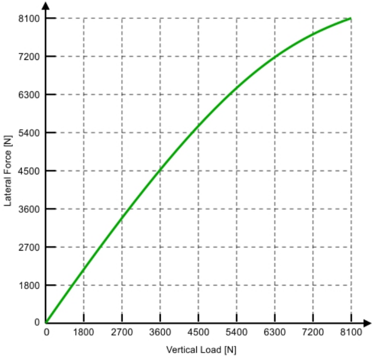

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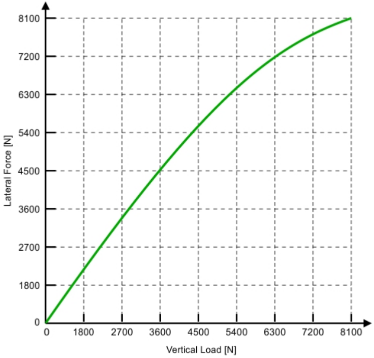

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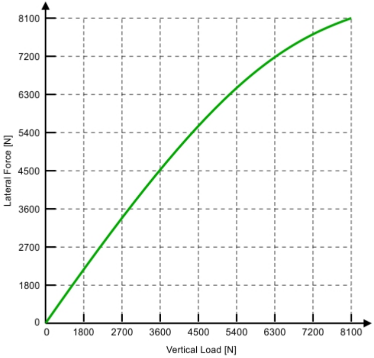


**Load Sensitivity is the singular most impactful thing in racecar design**

It alters practically every single decision