MAAE 2101 ENGINEERING DYNAMICS · CARLETON UNIVERSITY

Tesla Roadster

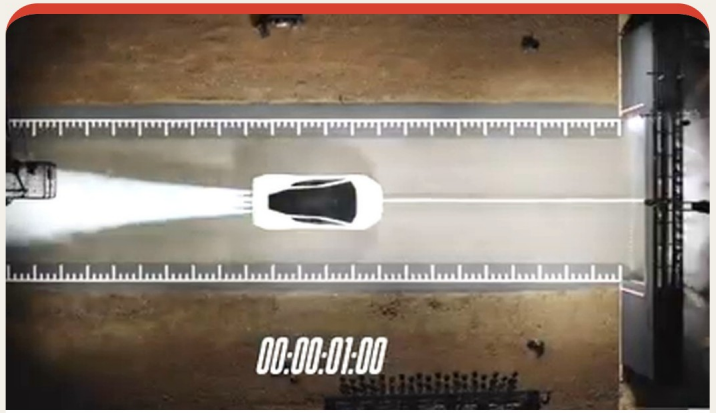
A rigid-body dynamics breakdown of the three Tesla Roadster stunts: the thrust launch, the inverted ramp and the kickflip.



Ahmad Bitar - Abdalla Ubaid - Dalu Obiakor - Mohamad Chahrour

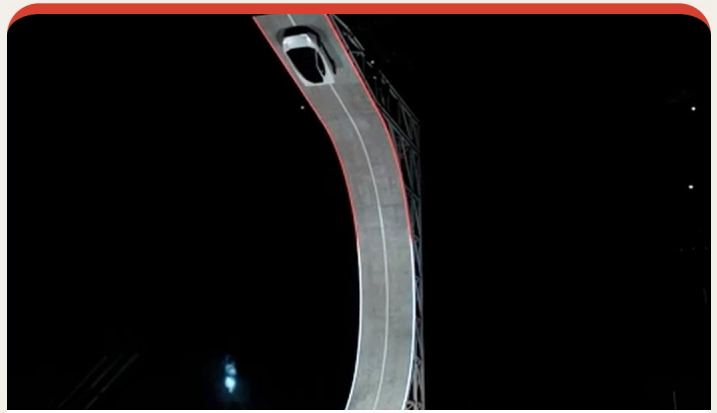
THE QUESTION

Each stunt breaks a rule cars live by



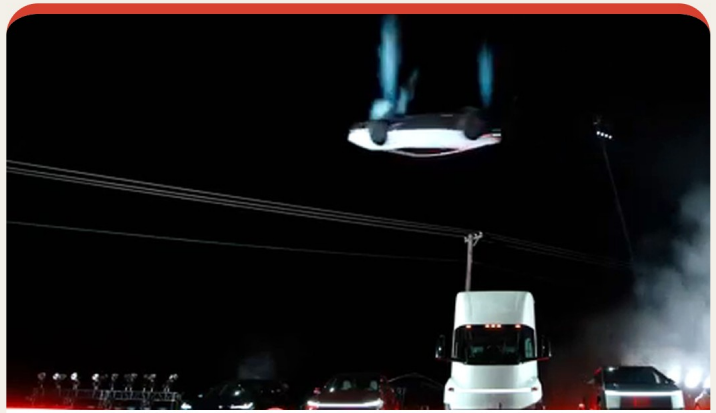
Thrust launch

Tyre friction should cap acceleration near 1 g. Tesla claims 0–60 mph in 0.81 s.



Inverted ramp

A car can't stay on a surface once gravity points away. This one drives to 170°.



Kickflip

No ramp at all. The car lifts off, rolls 360° over a row of trucks and lands.

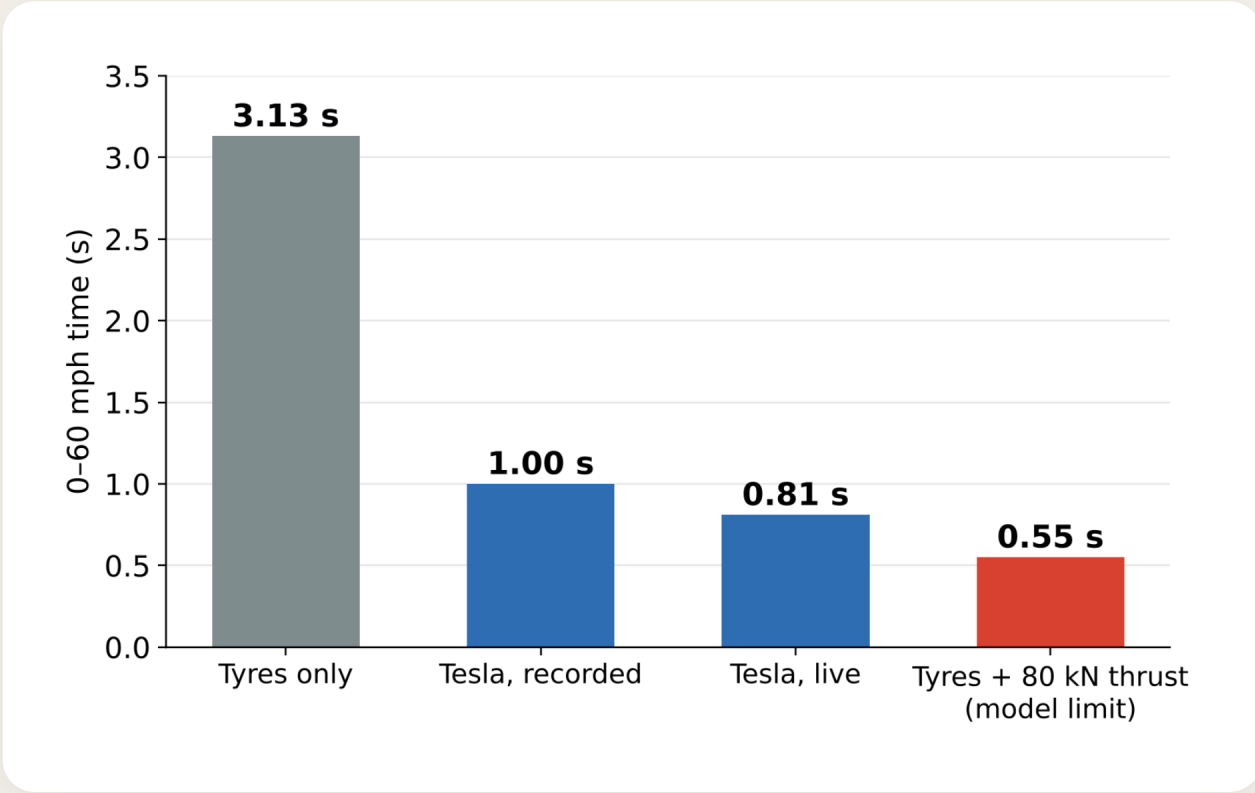
Stills from Tesla's Roadster unveiling, Oct. 15, 2026.

1 · LAUNCH

The friction limit is avoided, not broken

3.1 s

Tyres alone top out near 0.9 g, about 3.1 s to 60 mph. The 80 kN of thrust pushes the car without going through the tyres at all, which is how Tesla gets under 1 s.

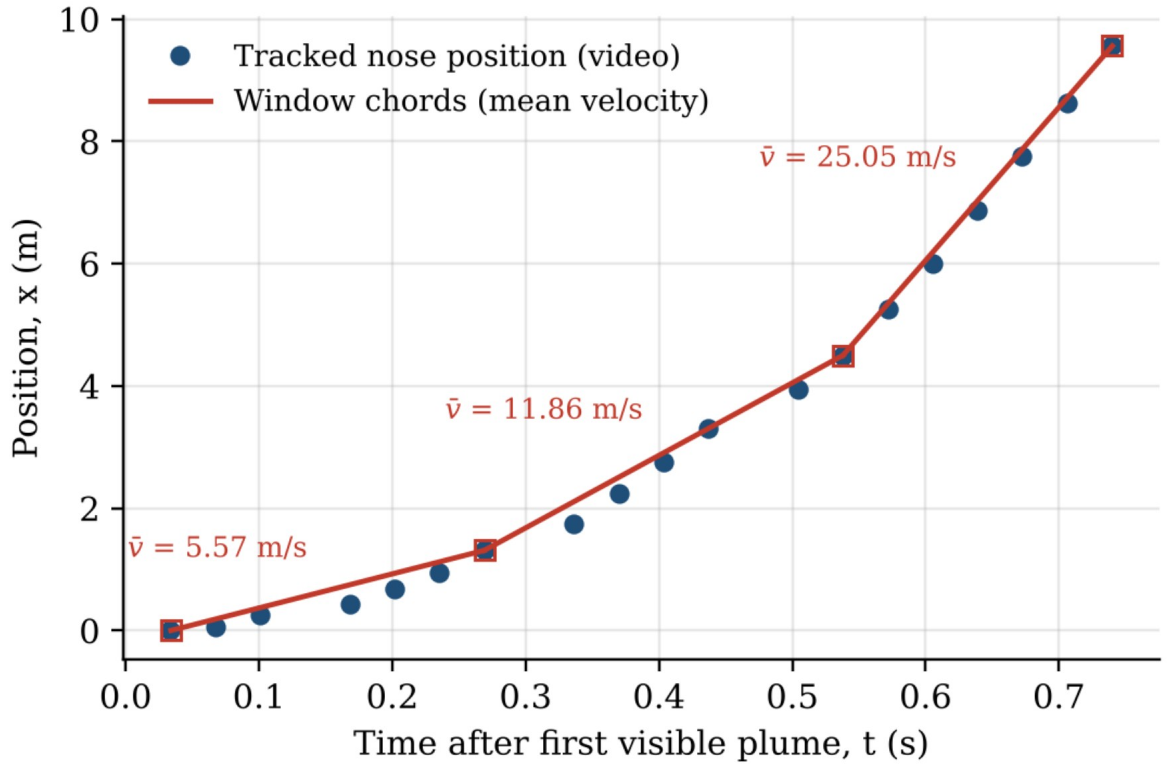


1 · LAUNCH, FROM THE VIDEO

The thrust builds during the run

3.4 g

Average acceleration from 0 to 60 mph in 0.81 s. Tracking the car frame by frame shows it isn't steady: it starts near 2.5 g and climbs as the thrust comes up.

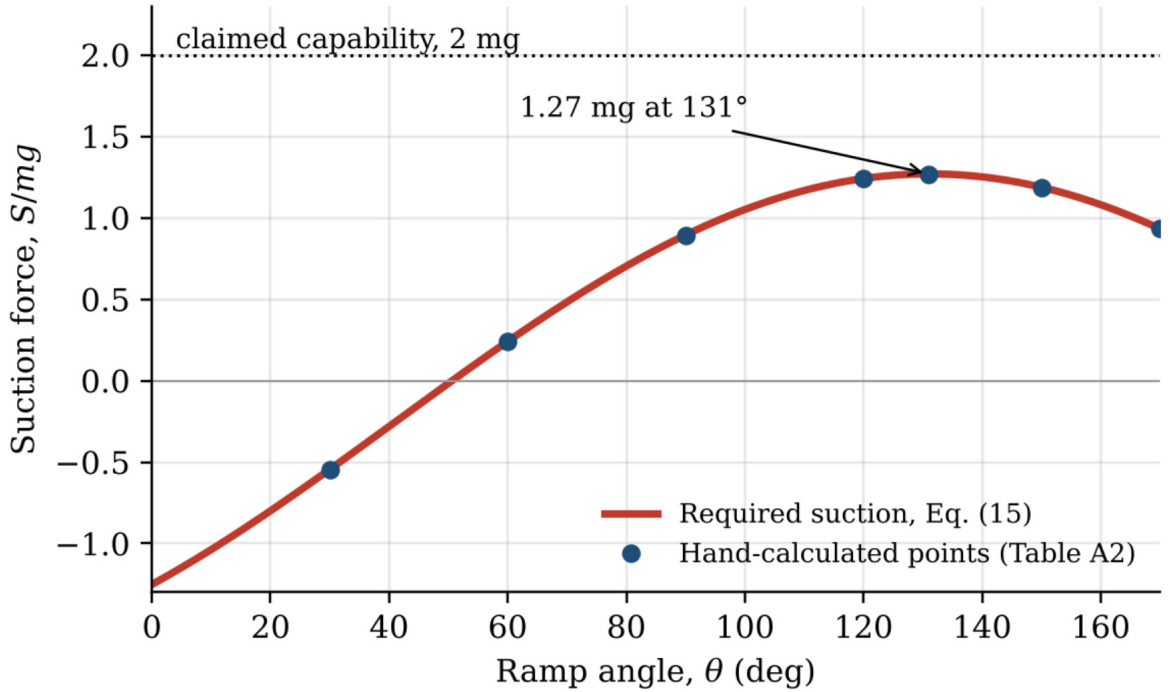


2 · INVERTED RAMP

The hardest point isn’t upside down

131°

There the tyres still carry most of the climb while gravity already pulls the car off. It needs suction of 1.27× its weight, against a claimed 2 g.

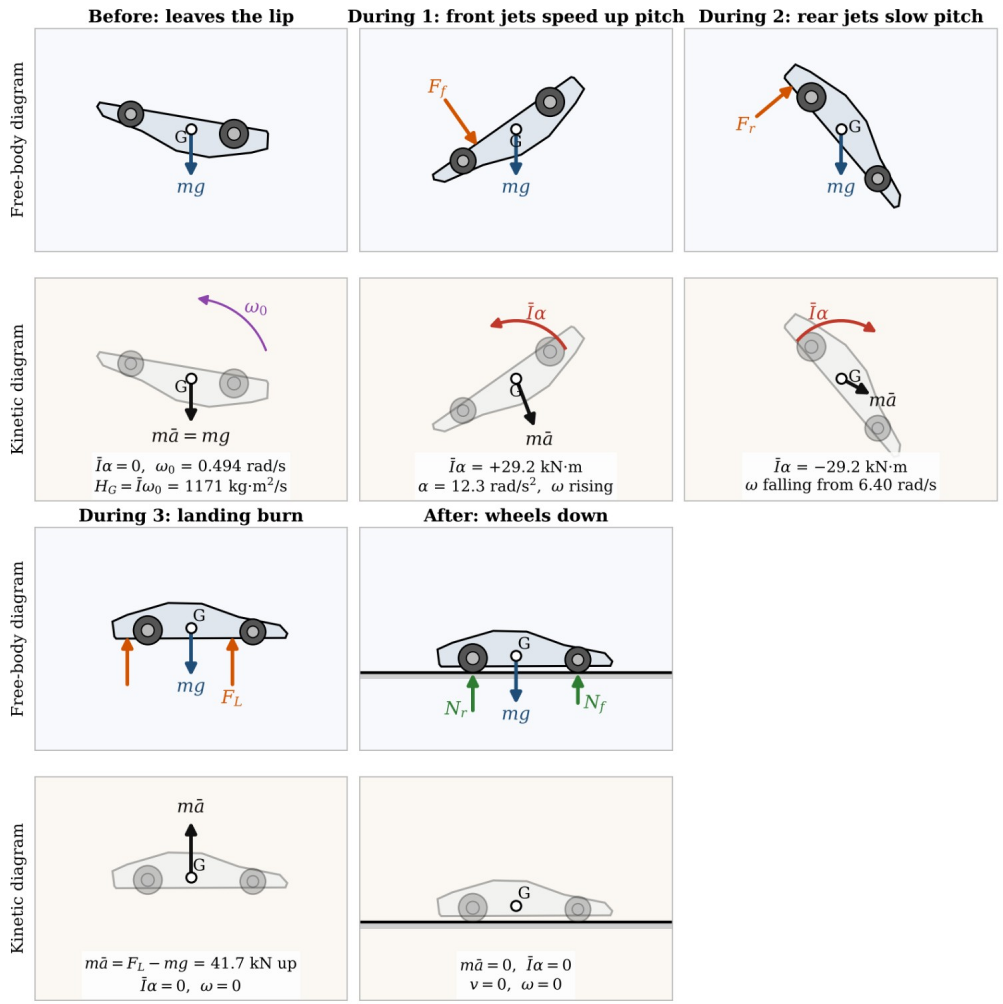


2 · OFF THE LIP

Without thrusters it lands on its roof

60°

Spin from the ramp turns the car only 60° of the 190° it needs. Jets add a 29 kN·m pitch moment, then a 60 kN burn from about 6 m stops the fall.

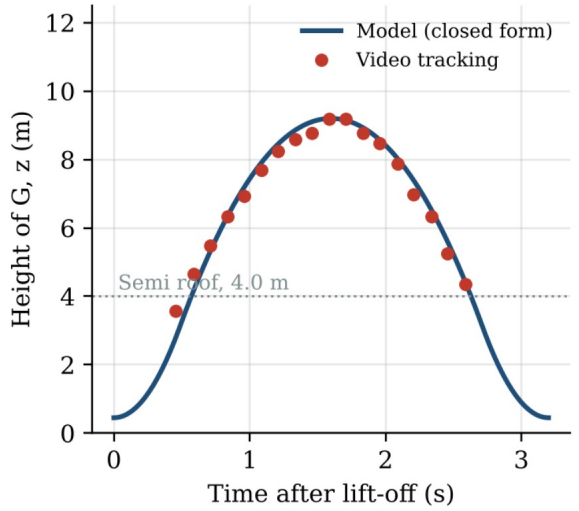


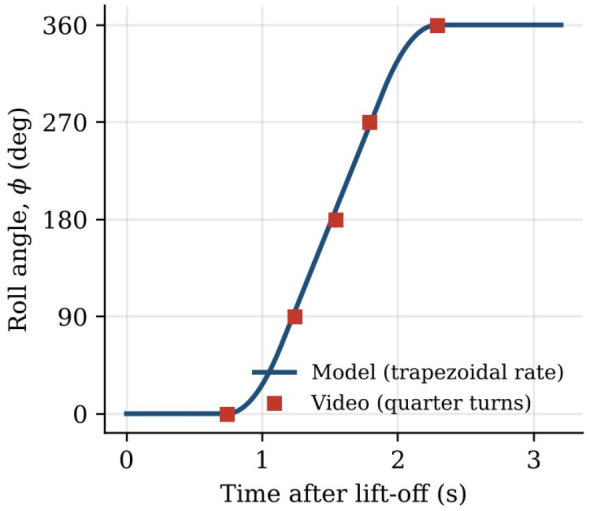
3 · KICKFLIP

Rotation is cheap. Lift is expensive.

6 %

The 360° roll takes only 6 % of the jump's energy. A 0.49 s boost lifts the car 9 m, and the model matches the tracked flight to within 0.2 m.





60 kN
Take-off thrust

3.3 g
Thrust ÷ the car's weight

0.49 s
Boost, then 10.9 m/s up

HOW WE CHECKED IT

Every main result worked out

Impulse–momentum = work–energy

Mean launch force 61.3 kN both ways

Kinematics = conservation of energy

19.9 m/s impact speed from the lip, both ways

Model against video

Free flight measured at −10.0 m/s², within 2 % of g

Moments about G and about the tyre

Axle loads on the launch and the ramp agree

Angular impulse = work of a couple

Pitch and roll moments were confirmed

Against independent analyses

Agreement within about 10 %

Mass properties estimated with a composite-body model. Full report available on request. Thanks to Dr. Edward Cyr.