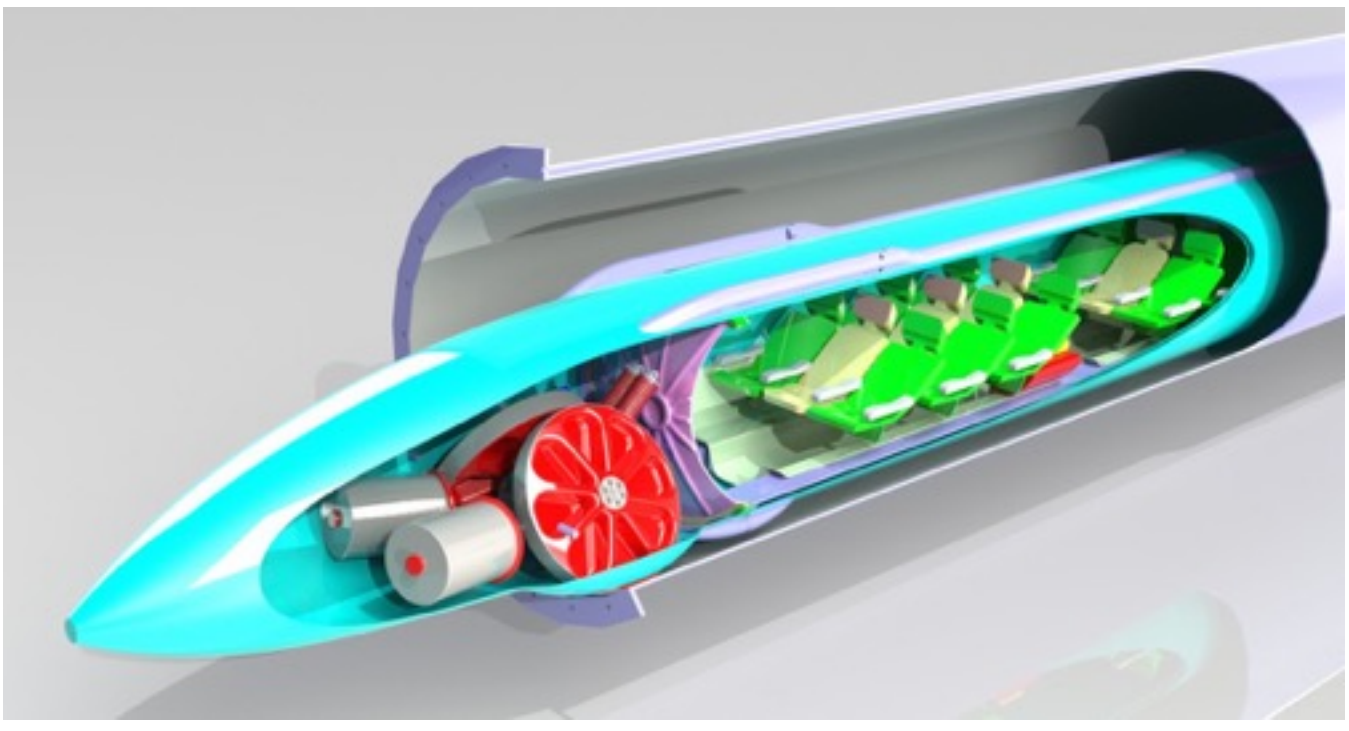
Hyperloop Cheetah

Hyperloop Cheetah is a 27-seat pod with wheels. It was first published in January 2014. The 4 wheels run directly on the surface of the tube. It has 27 seats in three 9-seat modules.

All of the technology topics for Cheetah are described in greater detail on separate pages.



There are 4 electric motors on the wheels, with power supplied by an internal battery. The maximum acceleration is 0.3g.

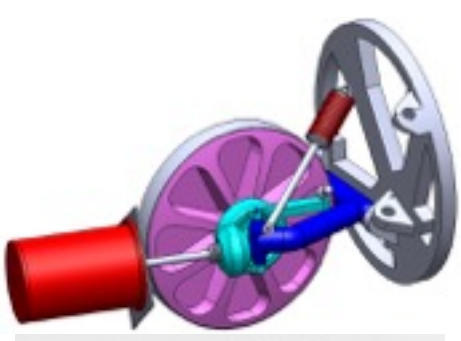
Cheetah - sleek, fast and very smart

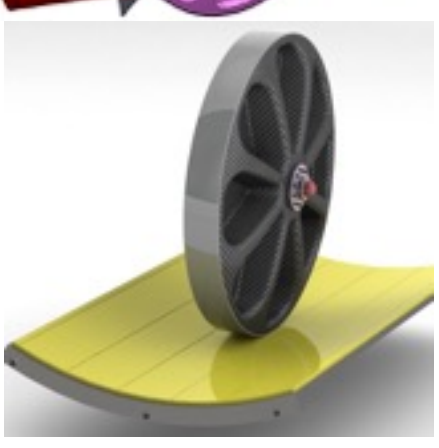
Wheels, pneumatic tire or steel rim

This is the proposed wheel and suspension layout for Cheetah.

The pneumatic tire wheel is carbon composite or forged aluminium, with a tire specially developed for high speed.

The alternative is a carbon-composite wheel, with a hardened steel rim. The rim is sectioned, so that a single fatigue crack will not spread. The wheel has been FEA tested, and is structurally sound with the high rotational stresses. For the steel-rim wheel, the tube surface would be lined with hard rubber or PU, to smooth out the bumps and give good grip.





The usable friction coefficient would be up to 1.0 if required. This grip will give good performance.

Each of the four wheels is motor-driven, and angled for stability in the tube. Steering would adjust the bank angle to be correct at any speed in a curve.

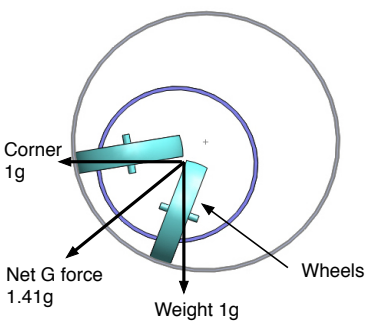
There would be no sideways forces, but prolonged traction and braking at about 0.3g. There is traction all along the route, for good average speeds and a smooth ride for the passengers.

The wheels are 1.3m diameter, 150mm wide (51”x 6”), and angled in the tube.

Running in the round tube allows variable banking

Cheetah will take fast curves with up to 1g side loading. This requires it to bank up to 45 degrees, the round tube will allow it to adopt the correct bank angle, so passengers always feel ‘upright’.

Rails could be used, but they increase the complexity and make it difficult in the high speed curves.



Hyperloop in a fast 1g curve, banked at 45 degrees. Passengers would feel extra 0.41g

Continuous traction gives passenger comfort and a fast trip

Cheetah’s wheels give traction all along the route, so the passengers feel smooth acceleration and braking. Despite the reduced acceleration, the trip time is only slightly longer than Alpha, which had limited lengths of 1g acceleration using linear motors (some called it a barf ride). Maximum power for acceleration is reduced from Alpha’s massive 32,700 kW to Cheetah’s 3,500 kW.

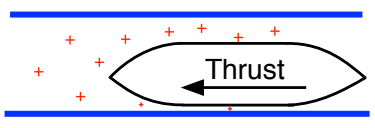
Round section and no side doors

Alpha images show a rectangular pressure hull, and large side doors. Both of these are impractical, due to the high pressure inside the hull in a vacuum. All pressure vessels are round for good reason, Hyperloop should be the same. The large side doors have massive pressure loads (10 Ton/sq m) and vacuum sealing problems.

Cheetah has a round section pressure hull for strength, and a screw-in end door for airlock access.

Kantrowitz - there is no limit

Alpha described the ‘Kantrowitz Limit’, and the speed limitations due to the back flow past the pod. This caused most Hyperloop designs to have a compressor to force the air internally through a duct in the hull. The compressor would be complex and consume considerable power.



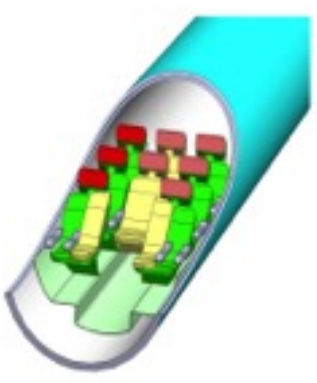
Pod with direct thrust, and external compression.

This ‘Kantrowitz Limit’ theory is incorrect, as it applies low speed, incompressible flow, to high speeds where the air is compressible. The back flow at low speed is due to the constant volume of the air, but the back flow reduces as speed increases and the air compresses. Cheetah uses its streamlined nose to compress the air outwards, with a much lower compression ratio. Elimination of the compressor gives a very simple design, with low power consumption.

Seating 3 wide 1650mm

Alpha proposed a narrow pressure hull, only 2 seats wide, which would be quite claustrophobic.

The Cheetah pressure hull is 1.8 m (71”) OD, and 1.65m (65”) ID. This gives space for 3 economy seats wide, and 2 more comfortable seats in business class. There is height to move down the hull for emergency exit.



Seating modules that move to the passengers

The end door of the pressure hull means that the seating modules need to roll out of the hull for passenger access.

This changes the station layout, because the autonomous modules can roll to where the passengers are, rather than the passengers walking to the pods. This leads to less walking, and less time in the station, so the station is smaller and more convenient.

The nose or tail lifts, to allow the end door to engage with the station airlock door. Then the seating modules roll out, and move to the passenger unloading first, then to the loading area.

The pod stays in the vacuum, saving time and energy. The pods only needs about 2 minutes for the airlock turnaround, so only 4 or 5 airlocks are needed for a 30 second pod spacing.