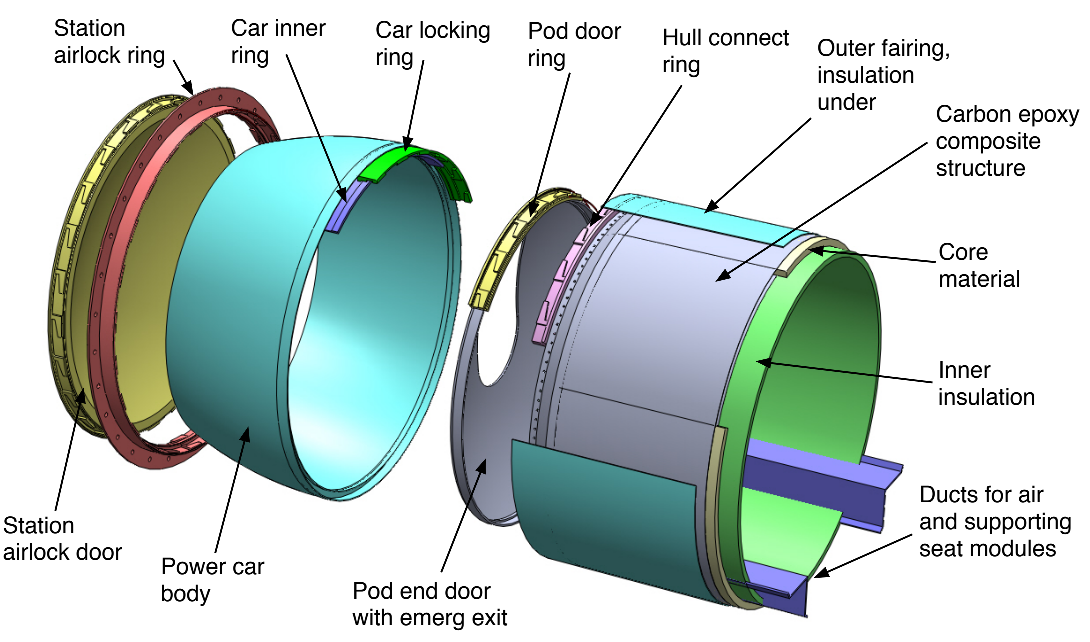
Carbon composite construction
The construction of the pressure hull is carbon composite, bonded to metal rings for the threaded connections and O-ring grooves.

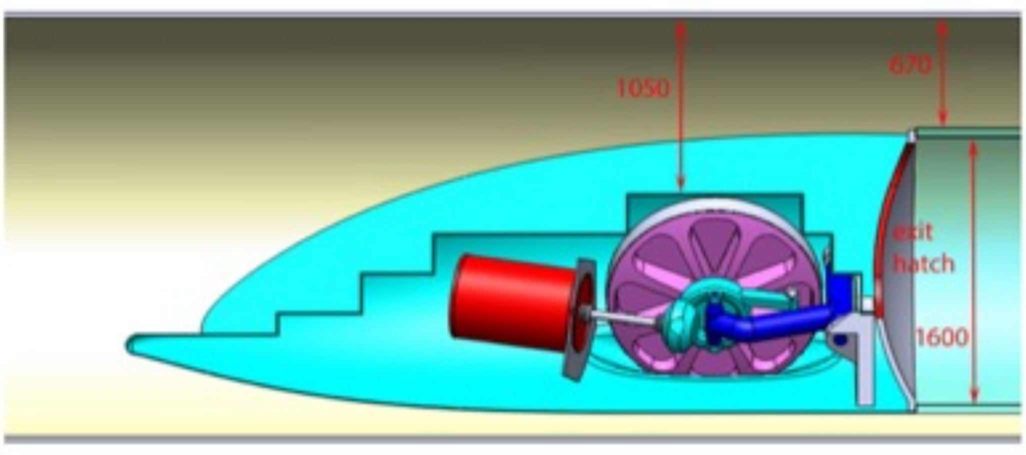
The pressure hull is a double-skin cored construction, and may have a layer of Kevlar to provide more protection against decompression in an accident.

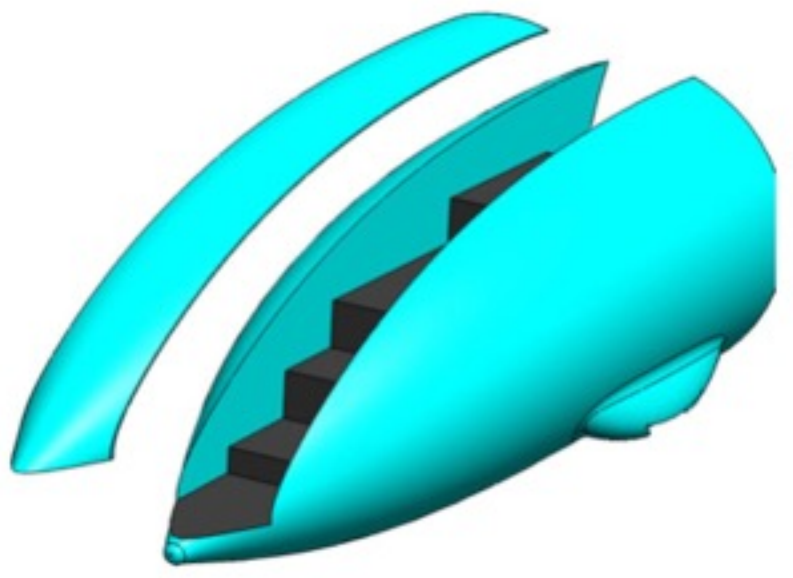


Emergency exit solution
Exiting the pod in an emergency is difficult. It is unlikely to happen, as in most situations it is better tho stay inside the pod, and maintain the vacuum in the tube. Fire cannot happen in the tube without oxygen.

But it must be possible for passengers to leave the pod. Side doors cannot be opened. There could be a crawl space on top of the pod, accessed by an overhead hatch, but there is limited headroom.

The best solution is to allow the passengers to walk over the front or back power car. There would be an inward opening hatch in the end airlock door, and a walkway with steps to the end. The minimum headroom is 1050mm (41”) immediately over the wheels, most of it is easy.



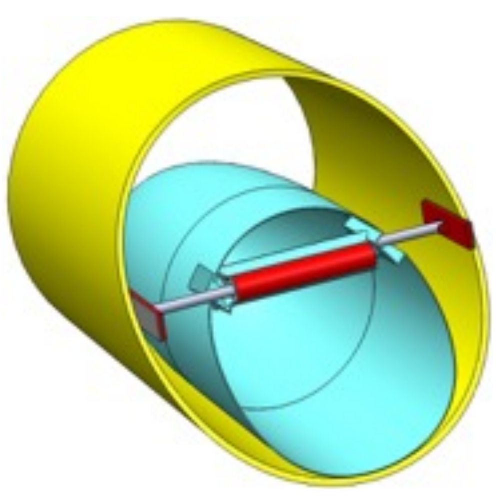


Emergency braking
Emergency braking is important, because it defines the safe spacing of the pods, and the ultimate passenger capacity of the system.

Hyperloop will accelerate and brake at 0.25g to 0.4g, to give a comfortable ride for the passengers. The tires will have the grip to provide up to 1g to 1.2g of braking, but the motors and electronic drives may not have the capacity for regenerative braking at that rate. Friction disc brakes on the wheels will not work in the near-vacuum, as the disc will overheat quickly.

The regenerative braking may have the capacity for braking up to 0.6g to 0.8g, but that is not enough for emergency braking. Also, we have to consider emergency braking if all the electronics has failed.

So we need a fail-safe system, capable of 1g to 1.5g braking from 1,200 km/hr. Friction brake pads can be forced directly against the tube walls, even at high speeds they should not overheat because they are always in contact with the cool tube wall. Brake pads have a friction coefficient of 0.45, so the combined force on the pads needs to be 2-3 times the vehicle mass.



The proposed solution for Hyperloop, is to have a number of hydraulic cylinders projecting out from the pod, with brake pads contacting the sides of the tube. They will be powered from separate pressure reservoirs, and normally held in by the electronic control system. When commanded, or following any system or electrical failure, the pads will spring out and provide more than 1g of braking.

Aerodynamic braking could be provided as a back-up, this could be flaps that spring out from the pod to block the tube, or maybe a parachute system.

Stopping distances from 1,200 km/hr are
- 11.3 km at 0.5g
- 5.7 km at 1g
- 3.8 km at 1.5g.

Hyperloop Cheetah Specifications

Hyperloop Cheetah is an evolving project, the figures below may not represent the latest version of the design.

Maximum speed 1,220 km/h (760 mph). LA-SF trip time 35 mins approx.
Pressure hull size, 1.65 M (65”) internal diameter, length 13 M. Pod length 22 M (72ft)
Pod external dia 1.8 M. Tube internal dia 2.7 M (8ft 10”). Tube/pod area ratio=2.16
Construction - monocoque using carbon/epoxy/honeycomb pressure hull.
Weight 6,000 Kg empty, 10,000 kg (19,800 lb) loaded.
27 Passengers, 9 rows of 3 economy or 2 business. 3 seating modules rolls out at station.
Full-size airlock door on front, plus 2 emergency exits and temporary aisle between seats.
4 wheels, 1,300 mm diameter x 150 mm wide (51”x 6”). 4,900 rpm.
Wheels, forged aluminium alloy, or carbon/epoxy with pneumatic tires or a hard steel rim.
4 electric motors, 900 kW peak power.
Acceleration, 0.25g up to 430 km/h, then limited by 3,500 kW power, 0.12g at full speed
Cooling water for trip 250 Kg, steam ejected to tube and compressed to condensers.

Energy consumption is just 4% of other transport
The estimated full-speed cruising energy consumption for the pod is 140 kW, this increases to 352 kW when including braking losses, cooling power and motor efficiency.

The energy used per passenger per unit distance (40 kJ or 11 Whr per Passenger-km) is about 4% of other forms of public transport.

Compared to the Tesla Model S, which is extremely efficient transport, one Hyperloop Cheetah pod uses 33% more energy for the whole trip, but carries 27 passengers.

Tube absolute pressure Pa	100
Tube inside diameter M	2.500
Power consumption kW (avge over trip)	
Wheel & bearings rolling power	58.9
Kantrowitz Compression power	53.2
Skin friction power	28.5
Avge power loss for braking	71.4
Motor and gearbox power loss	37.4
Cooling steam pumping power	103.3
Total Electrical Power kW	352.6