Test Pod for competition or adventure ride

This test pod was designed primarily for the 1-mile tube in the 2016 Pod Competition. It is also suitable for any small-scale Hyperloop testing.

George Burdell suggested that it would make a good adventure park ride, the test track could be used for testing, but also generate income as a ride.

Performance
1-mile tube, 350 km/h (220 mph)
Amusement park ride
Max speed 350 km/h (220 mph)
Min turn radius 500m (1,640 ft)
G-force in curves = 2g

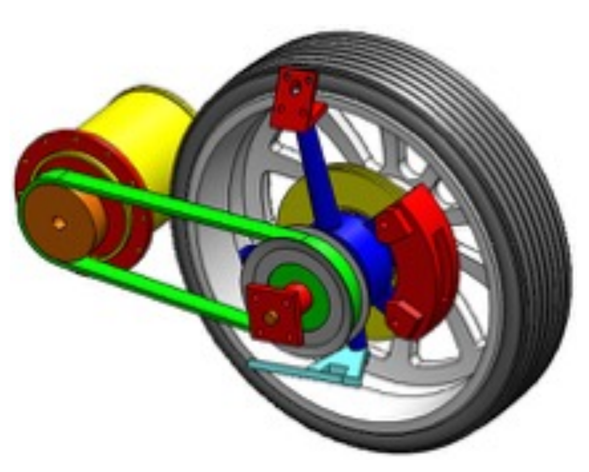
Specifications
Length 7.9m (26ft)
Pod OD 850mm (33")
Pod ID 750mm (30")
Tube dia, min 1200mm (48")

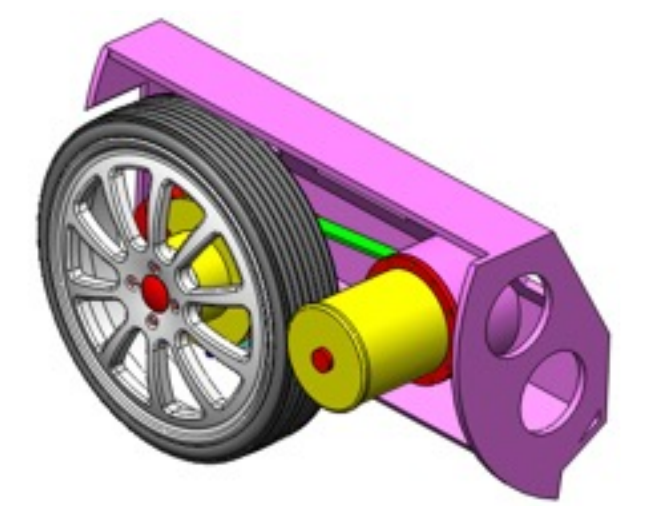
Wheels modules adjustable:-
Angled for running in the tube
Upright for running on the flat

Power
4 electric motors, total 200 kW

Passenger loading
Pod passes thru airlock
Screw thread and O rings one end of pressure hull. Tail lifts up, end unscrews, seats roll out.

Competition pod design and construction





The competition pod is a half-scale model of the full-sized Hyperloop.

The pod consists of two power cars, connected by the centre section. A 2-crew pressure hull could be used, but for the competition the centre section will be a simple composite tube.

The power cars each have 2 suspension modules, with their own wheel and 50 kW motor.

The separate suspension modules can be assembled into the power car at the correct angle to suit the diameter of the tube, or with the wheels vertical to suit a flat floor.

The wheels and suspension are from the front of a small front-drive car, including the hub and ABS brakes. The McPherson strut is cut down, and has limited travel using rubber bushes. The images show 18" wheels with a 125/60R18 low profile tire. 15" wheels with normal profile tires could be used.

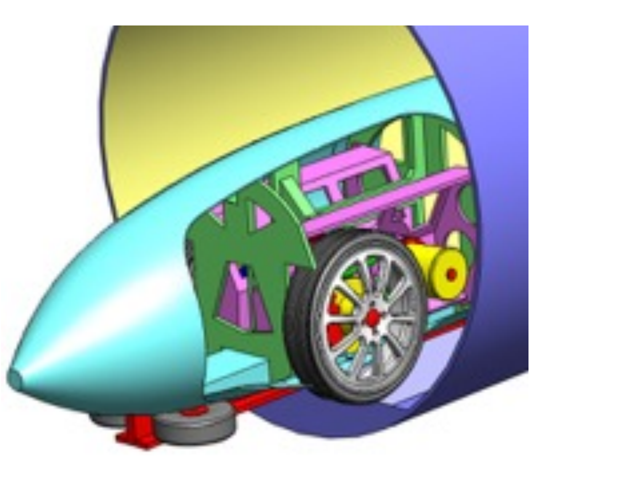
High-performance road tires should be suitable for the Pod Competition, but soft racing slicks would give better grip and higher speed. For extreme speeds, dragster front tires are rated to 550 km/hr (340 mph), and land speed racing tires are available from Mickey Thompson rated at 475 mph, 760 km/hr

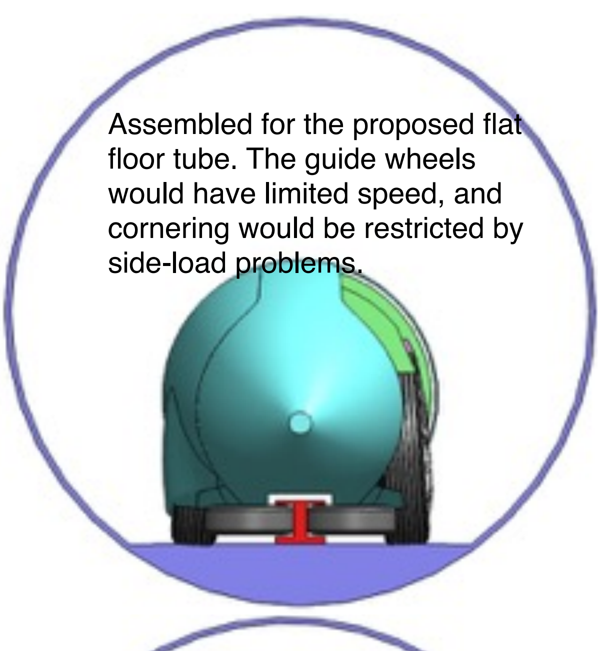
Toothed timing belt transmission has been chosen for simplicity, for the 50kW motors. Hyperloop would use a bevel gearbox and shaft-drive to the motor.

The pod will be constructed of fibreglass composite, with the framing formed from core materials that are suitable for vacuum use.

Running in the tube proposed for the 2016 Pod Competition

The proposed tube has a flat floor, with a central rail. The wheels need to be assembled vertical, and smaller side wheels used to locate the pod on the rail.

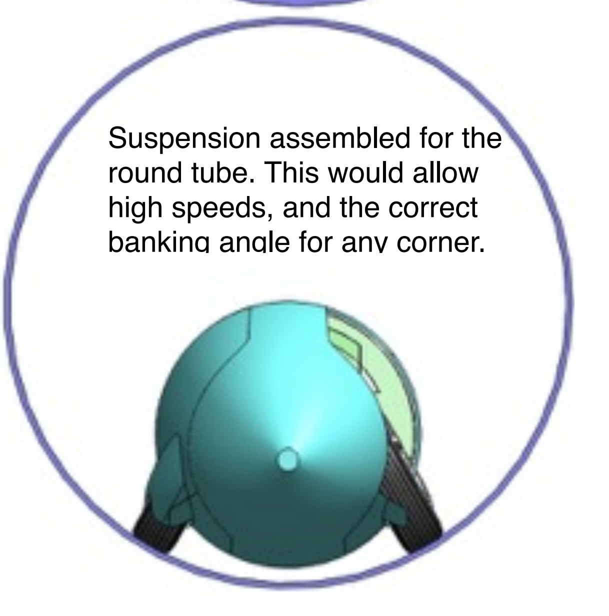




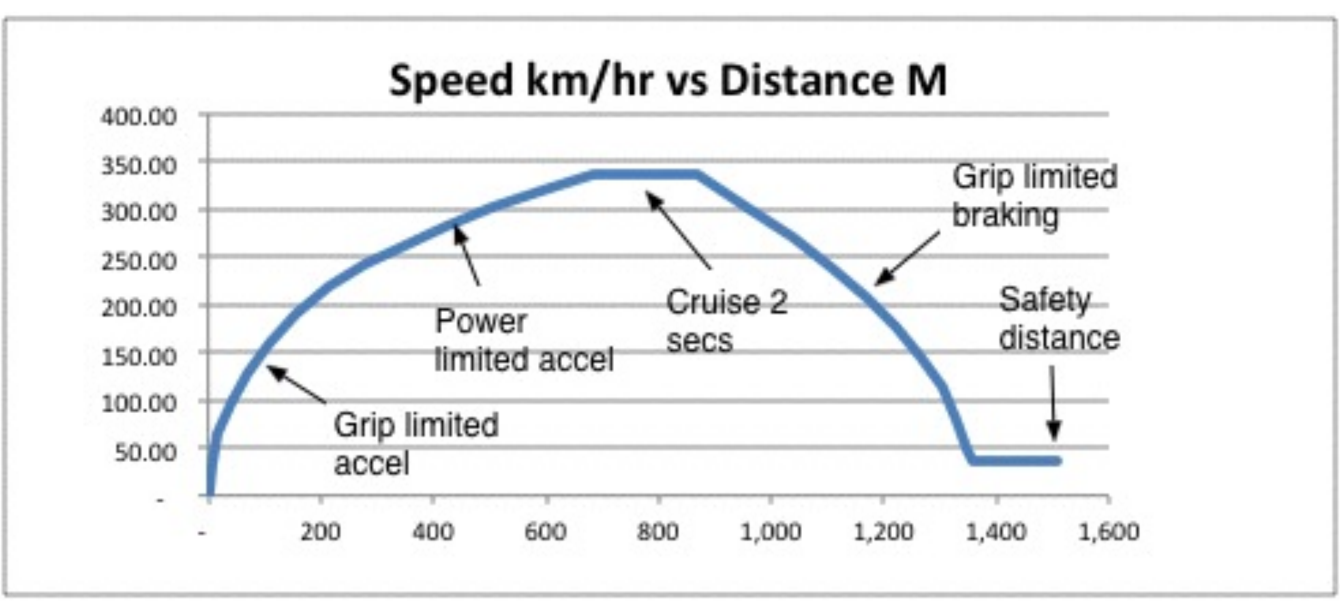
Running in the curved tube

The wheels are angled, and must be mechanically stable inside the tube. It will use automotive suspension, with the normal steering characteristics that allow hands-off stability at any speed. The suspension can be assembled to give a range of caster angles for optimum stability.

The pod will also be fitted with a steering system based on accelerometers (electronic gyros) to keep it level in the tube. If this fails, the mechanical stability will keep the pod safe.



Maximum speed in the 1-mile tube

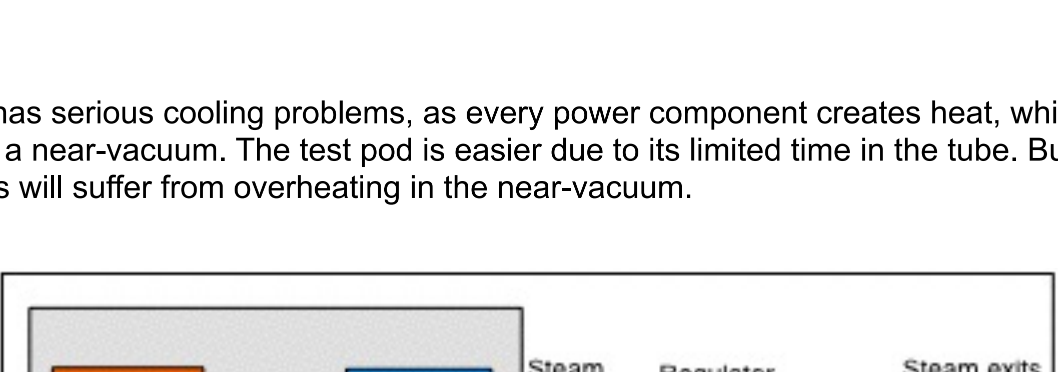


The tires should have a reliable friction coefficient of 1.0, soft racing tires go up to 1.4.
The chart shows a 0.9g acceleration, a 2 second cruise, and 0.9g braking, the maximum speed for the 1-mile tube is 208 mph, 335 km/hr. This is conservative, and allows for a 250m braking safety margin before the end of the tube. 250 mph, 400 km/hr is possible with soft racing tires.

The acceleration rate of 0.9g is quite achievable for a 4-wheel drive, lightweight electric vehicle. Tesla's 'ludicrous' mode accelerates at 1g. The pod will be fitted with standard automotive ABS, and the 0.9g braking rate is very moderate.

Cooling

Hyperloop has serious cooling problems, as every power component creates heat, which is hard to dissipate in a near-vacuum. The test pod is easier due to its limited time in the tube. But any electrical components will suffer from overheating in the near-vacuum.



The cooling system will consist of a cool-box maintained at atmospheric pressure, for all the electronic components. The cool-box is chilled by a water supply, which is vented to the vacuum in the tube with a 4 kPa relief valve. At this pressure, water will boil at 25C and the temperature will remain stable.

Ice-bags could be a simpler cooling system, but all the electronics and ice needs to be in a pressure box at atmospheric pressure.

Spot cooling may be required, such as the timing drive belts. A fine water spray will evaporate immediately, creating an effective cooling stream.

Emergency Braking - Test Pod

The test pod will use regenerative braking, in combination with with ABS friction brakes. With the limited speeds, it is expected that the brake discs will not overheat. This should give 1g braking, or up to 1.3g with soft slick racing tires.

Test Pod Powertrain and Batteries

This section is an estimate, and will be updated with the cooperation of the motor and electronics supplier.

The pod has 4 wheels, each with a motor. For simplicity, the drive to the wheel is a timing belt. This could overheat in the near-vacuum, and may need spot cooling with a water spray.

The following figures assume a 500 kg pod,
- Acceleration 0.9g, limited by tire grip, to 165 km/hr
- Accel limited by 200 kW of power, down to 0.42g at 350 km/hr
- Max speed 350 km/hr after 14 seconds
- Cruise 2 seconds at 350 km/hr
- Braking at 0.9g down to 10 m/s
- Slow cruise at 10m/sec, 1600m to end of tube.

The 4 motors are geared 2.25:1, to give a rpm of 6000 at 350 km/hr. They each need 172 Nm of torque, and a maximum power of 50 kW.

The battery capacity is determined by the maximum current output, rather than the capacity. Based on RC Lipo batteries, it would need 60 kg of batteries, with a total capacity of 8 kWHr. The pod would be able to do several runs on one charge.