

wind shear refers to change in wind speed and/or with varying altitude. It can be vertical (change in wind parameter as we move from one layer of atmosphere to another) or horizontal when wind parameter within an atmospheric layer changes.

wind shear can have significant impact on parachute deployment :-

i) Stress of Parachute's structure :- Increased wind shear in the opposite direction of rocket's descent, will increase the drag on parachute's canopy, leading to higher amount of stress on it, which can hamper the structural integrity of the parachute.

(ii) uneven wind shear

uneven wind shear may lead to uneven inflation of the parachute, so if one section of parachute inflates more, then it'll have more effective area, leading to higher drag force, leading to generation of torque about the axis of parachute leading to rotation, or possible collapse of the structure due to entangling of ropes. Thus wind shear is a major threat to stability.

(iii) Problem with descent rate

Strong wind shear may lead to an increase in drag force, slowing down the rocket, but this can be achieved only till a certain extent, after that the higher drag force may lead to an increase in terminal velocity of the rocket, making the impact harder, which can be dangerous for the rocket.

Further if the wind shear leads to a decrease in drag it will too lead to a greater ~~as~~ speed while descending causing the same problem. This can occur near the Earth's surface.

(iv) Controlling the location

The horizontal wind shear will cause horizontal shift, deviating it from the path it was supposed to follow, thus ~~leading~~ making the location control difficult.

(v) Sudden ~~changes~~ changes in drag due to wind shear can cause impulse forces on to rocket's structure, which can also lead to complete detachment of the parachute mode or to excessive stress of structure leading to damage to the ~~inter~~ delicate components.

(vi) Parachute deployment timing

A rapid change in wind parameters may lead to unpredictable and unstable parachute deployment.

→ Like, if it is altitude-based deployment, then the wind shear may cause rapid change in altitude, thus the actual altitude may differ from predicted altitude thus leading to premature or delayed deployment.

→ In case of time-based deployment, wind speed can change rocket's speed substantially, making it getting deviated from the altitude which was predicted for a particular time, thus leading to parachute deployment at uninvoked altitudes.