How retractable landing gears work

Transportation

Since their initial conceptualization in 1800s, the idea of creating a system which can both fold up and withstand tremendous air forces and weight, has been a daunting one.

There is a specific velocity for aircraft, above which the drag caused by the added weight of a retractable landing gear system is less than the drag that would have been cause had the landing gear not had been retractable. Most often, it is advantageous for all aircraft to have retractable landing gears.

There are many different techniques which may be used to make the landing gear retract. A few are even mechanical – the pilot extends and retracts the landing gear via a lever. The simplest contains a lever in the flight deck mechanically linked to the gear. Through mechanical advantage, the pilot extends and retracts the landing gear by operating the lever. More common however is the use of a roller chain, sprockets, and a hand crank which decreased the required force by the operator.

Electrically operated landing gear systems are also found on light aircraft. An all-electric system uses an electric motor and gear reduction to move the gear. The rotary motion of the motor is converted to linear motion to actuate the gear. This is possible only with the relatively lightweight gear found on smaller aircraft.

The landing gear is often overlooked in favor of the compelling engine by passengers, however they often judge the quality of the flight by the smoothness of the landing and rely on it for a safe return to ground.

Normally, the landing gear is built around a single vertical strut with the wheels located at the bottom. This setup means, however, that the impact of landing is transmitted directly to the cabin floor, thus a substantial bump is felt.

However, the trailing arm suspension, which is used in the Gripen E is much more forgiving.

Trailing arm suspension

The trailing arm suspension, however, is not based upon a straight rod and is instead the shape of a L, which functions like a lever which uses a angular shock absorber which muffles the hardest of impacts. The fact that the main gears are not attached to the body but the wings means that the shock transmitted through the trailing arm suspension will also be dampened by the flexibility of the wings.

Trailing arms connect the chassis, rear axle, and shock absorbers. First, it must provide an link between the chassis and the rear axle. Next, as the shock absorbers are mounted to it, it must support the weight of the vehicle as well as the tension and compression forces generated between the rear wheels and the chassis. Finally, trailing arms need to be strong enough to withstand random hits from random objects such as rocks, roots, and dirt.

The trailing arm is most definitely the most essential part of the landing gear: it is attached to the wheel, the shock absorber and essentially a piece of metal directly attached to the plane. This means, that approximately a third of the weight of the jet (in this case, assuming maximum load, approximately 55000kg) must be supported by the structure. In reality however, this is not the real test. The point at which the trailing arm will be under the most stress is upon impact with the ground (landing). The shock absorber, known as an oleo strut is a pneumatic air–oil shock absorber. This design cushions the impacts of landing and damps out vertical oscillations. This is because it increases the ‘ impact time’ between the wheel and the ground. As the force exerted on the aircraft equals the total impulse divided by the time of contact between the wheel and the runway, increasing the time reduces the force. The impulse is the same as the change in momentum of the aircraft so the impulse on one of the landing gears equals the vertical velocity times 55000 (the weight it’s supporting assuming each 3 wheels supports equal proportions of the weight).