Center of Mass Encyclopedia Article

Center of Mass

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The center of mass is a fairly self-explanatory term: it is the location that is in the direct center of an object or system, in terms of the mass of that object or system. For uniform objects, the center of mass is a geometric center, but this concept can also take into account objects whose composition varies, changing the way the mass is distributed. It also covers systems which are only connected by forces: the Earth-moon system's center of mass can be calculated, taking into account the mass of both celestial bodies.

Center of mass can be calculated for discrete systems or for continuous systems. For discrete systems, the mass of each piece of the system times the vector position of that piece is summed over all the pieces of the system. Then the result is divided by the total mass of the system, giving a vector position that is defined as the center of mass. For continuous systems, this discrete sum is changed to a continuous integral, so one integrates over the mass function (as dependent upon position) times a position function, over the **limits** of the object or system.

The center of mass can be a useful physical or engineering concept, as single forces can be applied at the center of mass to move or contain an object without torque. If the center of mass calculations are not used, the forces to move or contain the object must be balanced. In the earth's gravitational well, center of mass is sometimes dealt with in the form of the center of gravity.