

58.4: The Hohmann Transfer

On occasion we need to re-shape an orbit. One common situation is that we need to move a spacecraft from a circular orbit to another circular orbit with a different radius. How do we do this?

It can be shown that the most efficient method for performing such a maneuver is to connect the two orbits with an ellipse that is tangent to one circular orbit at its perigee point, and tangent to the other circular orbit at its apogee point (Fig. 58.4.1). One changes the spacecraft velocity twice, using two engine burns: one burn on the initial circular orbit to create an elliptical transfer orbit, and a second burn at apogee or perigee to circularize the orbit. This type of two-burn maneuver is called a Hohmann transfer.

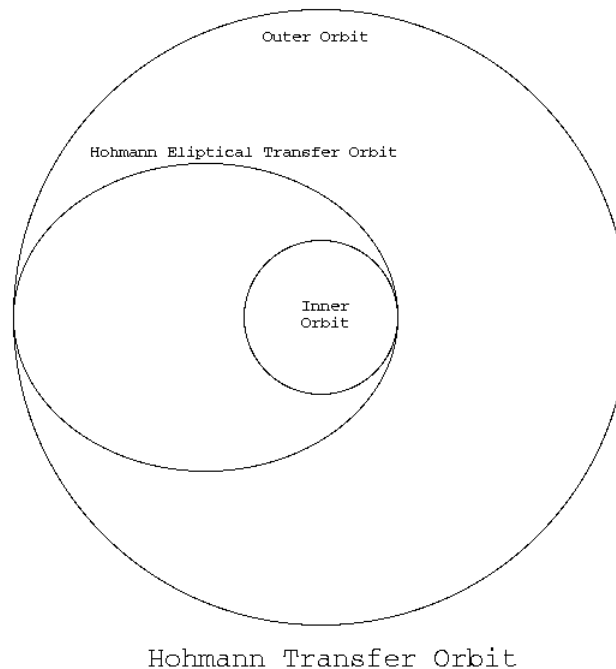


Figure 58.4.1: A Hohmann transfer orbit.

One can use a Hohmann transfer to move a spacecraft from a low-altitude circular orbit to a higher-altitude circular orbit by increasing the speed with the first burn to create an elliptical orbit with the desired apogee, then circularizing the orbit with the second burn. The Δv for the first burn will be given by the negative of Eq. 58.3.21, and the Δv for the second burn will be given by Eq. 58.3.22 (Both Δv burns will be positive, since both will be adding energy to the orbit.)

To move a spacecraft from high-altitude orbit down to a low-altitude circular orbit, one decreases the speed with the first burn to create an elliptical orbit with the desired perigee, then circularizes the orbit with the second burn. The Δv for the first burn will be given by Eq. 58.3.22, and the Δv for the second burn will be given by the negative of Eq. 58.3.21. (Both Δv burns will be negative, since both will be subtracting energy from the orbit.)

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