2.5 Establish Position of Target at Time of Launch

The time of launch must be coordinated with the position of the target satellite in its orbit at the launch time. This is obtained by working backwards from the rendezvous point and equating the times for both vehicles to reach this point. These times are measured in the final orbit relative to perigee.

The time for the homing satellite to reach the rendezvous point is the sum of the time in the transfer orbit (t_t), the time in the waiting orbit (t_w) and the time of ascent to the waiting orbit (t_{ascent}).

The time for the target satellite to reach the rendezvous point is divided into the time before perigee crossing (t_{1f}) and the time following perigee crossing (t_{2f}). Since time is measured from perigee, t_{1f} has a negative value, and the target time is $t_{2f} - t_{1f}$. Equating the times of the two vehicles gives

$$t_{1f} = t_{2f} - t_t - t_w - t_{ascent} \quad \text{(Eqn. 2.5-1)}$$

Launch vehicle data gives t_{ascent} for the chosen altitude of the waiting orbit. Time in the waiting orbit,

$$t_w = n \, \tau_w \left(1 + \frac{\Delta\tau}{\tau}\right) \quad (2.5\text{-}2)$$

where

n is the integer number of revolutions in the waiting orbit, and
τ_w is the period of this orbit.
$\Delta\tau$ is the oblateness correction to the orbital period.

Roth gives this correction as

$$\Delta\tau = \frac{3\pi J_2 R_e^2}{a^2(1-e)^3} \sqrt{\frac{a^3}{\mu}} \, (3 \sin^2 \omega \sin^2 i - 1) \quad (2.5\text{-}3)$$