In dead reckoning, the fore-aft, port-starboard, and up-down velocities about the measured azimuth are resolved into velocity-north and velocity-east components, which are subsequently integrated over time:

$$\phi = \phi_o + \int_T \frac{VN}{R_N(\phi)} \, dt, \text{ latitude}$$

$$\lambda = \lambda_o + \int_T \frac{VE}{R_E(\phi)} \, dt, \text{ longitude}$$

where (ϕ_o, λ_o) is an initial position, VN and VE are the velocity-north and -east components, and R_N and R_E are the radii of the earth's curvature in north and east directions.

Each velocity component contains an error which is a function of both the relative velocity error, K, and the heading error, θ_e. Therefore, dead-reckoned latitude and longitude also contain errors which are (different) functions of the error parameters, K, θ_e:

$$\phi_e = f(K,\theta_e)$$

$$\lambda_e = g(K,\theta_e)$$

A position fix, if sufficiently accurate, immediately yields the position error (ϕ_e, λ_e). By neglecting second- and higher-order cross-terms as mentioned, the error parameters or "calibration factors" K and θ_e can be found directly.

Two requirements must be met for satisfactory calibration:

- The fixes at either end of the dead-reckoning interval must be sufficiently accurate
- The direct distance between fixes must be sufficiently large