Aerospace Engineering & Orbital Dynamics Technical Specification

Doc Ref: AERO-ORB-2026-SPEC | NASA/ESA Joint Telemetry Protocol

1. Fundamental Orbital Mechanics & Keplerian State Vectors

A satellite trajectory in a two-body gravitational field is governed by Newton's law of universal gravitation and Kepler's three laws of planetary motion. The six classical Keplerian orbital elements uniquely define the osculating orbit at epoch t:

a: Semi-major axis (determines orbit size and orbital period $T = 2\pi \sqrt{(a^3/\mu)}$).

e: Orbital eccentricity ($e = 0$ circular, $0 < e < 1$ elliptical).

i: Inclination angle relative to the equatorial plane.

Ω: Right ascension of the ascending node (RAAN).

ω: Argument of perigee.

ν: True anomaly (position of spacecraft along the ellipse).

2. Hohmann Transfer Delta-V Budget Calculations

Transfer Phase	Velocity Change (Δv)	Burn Specific Impulse (Isp)
LEO Departure Burn (r1 = 6678 km)	2.45 km/s	380 s (LOX/RP-1)
GEO Insertion Burn (r2 = 42164 km)	1.48 km/s	320 s (N2O4/MMH)
Station-Keeping Operations (per year)	0.05 km/s	3000 s (Hall Effect Thruster)