

ASTRODYNAMICS SYMPOSIUM (C1)  
Mission and Constellation Design (5)

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METHODOLOGY AND RESULTS OF ANALYSIS OF ZENIT, CYCLONE LAUNCH VEHICLES  
ORBITAL INJECTION ACCURACY

**Abstract**

The accuracy of spacecraft (SC) injection into a specified orbit is one of the most important launch vehicle flight characterizes. As a result of SC injection errors, the spacecraft orbital lifetime may reduce, the conditions of Earth observation and imaging and the other SC operating characteristics may worsen. In its turn, this may require installation of a SC vernier engine, increase of required propellant capacity, which finally may worsen the SC weight characteristics. In order to minimize the above losses, the modern launch vehicles are equipped with highly accurate control systems based on gyrostabilized platform and onboard computing systems that realize terminal flight control. In these conditions, it is important to ensure correctness of evaluation of expected accuracy characteristics based on the results of on-ground (laboratory, factory, pre-launch et al.) testing. Taking into consideration the fact that it is impossible to perform complete flight simulation on the ground, the results of a priori evaluation (before flight) shall be complemented with the data from flight tests and launch vehicles standard launches, thus obtaining a more correct estimate of injection accuracy. This paper is intended to review the methods of a priori and a posteriori evaluation of spacecraft orbital injection accuracy as applied to the launch vehicles of Zenit and Cyclone types, which hold a leading position among the most accurate present – day space launch systems. The main content of the paper is based on the research performed in the course of launch vehicles development by Yuzhnoye SDO in cooperation with allied organizations.