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THE DESIGN AND DEVELOPMENT OF A MEDIUM-SCALE LIQUID COMMERCIAL LAUNCH  
VEHICLE NAMED ZQ-2 BASED ON LIQUID OXYGEN AND LIQUID METHANE PROPULSION  
SYSTEM

**Abstract**

Liquid oxygen and liquid methane (LOX+LCH<sub>4</sub>), with the characteristics that are clean, non-pollution, low-cost and high specific impulse, are considered as the next generation liquid rocket engine propellant. The research and engineering development of liquid rocket engine based on LOX+LCH<sub>4</sub> propellant has recently become one main research direction. Studies on the launch vehicle design concept based on LOX+LCH<sub>4</sub> engines are still necessary to maximize the utilization of these technical advantages of LOX+LCH<sub>4</sub> propellants. This paper introduces the design, engineering development and implementation of a medium commercial liquid launch vehicle ZQ-2, based on LOX+LCH<sub>4</sub> propulsion system. ZQ-2 and the corresponding series of LOX+LCH<sub>4</sub> based liquid rocket engines named TQ are independently developed by Beijing LandSpace Space Technology Co., Ltd. ZQ-2 is a two stage launch vehicle, with four (4) 80t-thrust-level LOX+LCH<sub>4</sub> LRE engines named TQ in cluster configuration on the first stage to improve the stability in the transonic Mach regime. The total length of ZQ-2 launcher is 50m and the diameter is 3.35m. TQ-13 system is composed of 4 TQ-12 main engines with overall 2630kN thrust with their accessories mounted at the bottom of the first stage. Each TQ-12 main engine can achieve a ground specific impulse of 283s. TQ-16 system provides the propulsion for the second stage, with a total thrust 775.9kN and the specific impulse 333s in vacuum. Research shows that the carrying capacity of 500km Sun-Synchronous Orbit (SSO) can reach 1,500kg for the ZQ-2 launch vehicle system, which makes it the largest private commercial launcher in China.