

IAF SPACE PROPULSION SYMPOSIUM (C4)
Solid and Hybrid Propulsion (1) (3)

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COURSE AND CHALLENGES OF FLIGHT QUALIFICATION TEST CAMPAIGN OF THE
STUDENTS' HYBRID ROCKET ENGINE.**Abstract**

Hybrid rocket engines are recently of great interest to the scientific industry, because of their numerous advantages, like safety of operation, decent controllability, and relatively low complexity. Following this trend, work has also started within the Rocketry Division of the Students' Space Association at Warsaw University of Technology on a hybrid engine that utilizes hydroxyl-terminated polybutadiene (HTPB) and nitrous oxide. The engine is designed to be used in the Twardowsky cansat-launcher rocket project, that main goal is to take experiments in such form to the 10 000 feet apogee. Due to the nature of hybrid engine operation, this process required significant development of the Association members' approach to propulsion qualification testing as well as development of knowledge in the field of combustion models appropriate for this type of engines. Till now, the Association has only developed solid propellant motors with much simpler operating characteristics. Development of hybrid rocket engines shows numerous challenges in each phase of work. Many of them are discovered during a test campaign which is necessary and is one of the most important stages of development of rocket propulsion systems. This paper presents the most important challenges of qualifying the 2 kilonewtons hybrid rocket engine to flight, mainly: mechanical and electronic infrastructure, data acquisition, mathematical model correctness and safety precautions. All necessary stages of the complete test campaign are shown on the particular example of the Twardowsky rocket engine, including pressure proof tests, pyro valves tests, igniter tests campaign and most importantly, tests that give direct information about engine's performance, so cold flow and hot fire static tests. Experimental results of these tests and comparison to the current mathematical model is also presented along with the safety requirements and instructions that should be followed during each stage of the test campaign.