Initial tests’ test plan

Twardowsky 2 propulsion

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1. **Introduction**Within this document, the test plan regarding initial qualification tests of the propulsion system will be presented. Initial qualification tests are understood as tests, that verify readiness of individual subsystems and its elements for functional tests in conditions specified within project requirements. Main goal of this testing phase is to make sure, that assumptions and calculations accepted during mechanical model creation are compliant with reality, particularly with regard to the stress calculation of components and the design of subsystems’ seals. After that phase of testing, the next step is to begin functional tests campaign which consists of cold flow and hot fire tests.

Obraz zawierający tekst, zrzut ekranu, Czcionka, linia

Opis wygenerowany automatycznie

Fig 1. General scheme of qualification test campaign

In order to make sure, that conducted tests will be performed in safe way in accordance with stated requirements, each must be performed in conformance with pre-prepared checklists or test sheets which later have to be stored as a prove, that test took place. For safety reasons, tests involving pyrotechnic materials (gunpowder or solid propellants) require particular attention in the procedure. The integration of pyrotechnic components must always take place under the control of a person experienced in this field.

Obraz zawierający tekst, diagram, Plan, linia

Opis wygenerowany automatycznie

Fig 2. Initial tests’ campaign

The initial tests consist of several steps, the defined sequence of which must be followed. In addition, due to the different functionality of the subsystems, each has to go through a different route in the verification process. The components and subsystems concerned by the initial tests are listed below:

* Tank
* Main valve
* Vent valve
* Plug assembly
* Combustion chamber

**2. Tank**

Due to its role in the propulsion system, tank is critical component when it comes to pressure and leakage proof testing procedures. Its durability is determined by the weakest spot in its structure, which is the weld that joints the tank body with its ends. Tank has been welded using simple TIG method, which was chosen for it accessibility and based on previous experiences in Twardowsky project, where welding technology was particularly problematic. Tank leakage test is included in test plan, due to possibility of leakages on weld itself, in case when it was manufactured without cleaning precautions. The test is important because there may be holes in the weld of such small dimensions that pressure tests utilizing water will not detect the leak due to the low compressibility of the medium. For this reason, the fact that the leak test is carried out using air, a compressible gas, is crucial. In the case of target engine operation or when performing cold flow and hot fire tests, the medium that will fill the tank will be partly in the gas phase, which can lead to uncontrolled leakage at the weld.

The test should take place with a gaseous medium, the pressure of which can be easily controlled once the tank is full and can reach maximum pressures in the region of 1 MPa. Carrying out leak tests with higher pressure gases is not recommended for reasons of test safety. A compressible gas, unlike an incompressible liquid (e.g. water), stores much more kinetic energy during compression, which, if the tank is destroyed, can lead to a risk to the life or health of the test participants. At the time of writing, it is assumed as standard, to use a compressor with a maximum operating pressure of 8 bar for this purpose. A compressor with such parameters has been used on numerous occasions during the tests of the Twardowsky 1 engine.