DEVELOPMENT OF A METHOD FOR DETERMINING THE TRAFFIC CHARACTERISTICS OF THE electrodeless PLASMA ROCKET ENGINE BPRD-100 BASED ON THE RESULTS OF MEASURING THE PARAMETERS OF THE PLASMA JET [[1]](#footnote-1)\*)

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Currently, the National Research Center "Kurchatov Institute" is working on creating a mockup of the electrodeless plasma rocket engine BPRD-100. Design parameters of this engine: power 100 kW, thrust 3 N, specific impulse 5000 s, thrust efficiency ≈ 70%.

As a rule, electrojet engines (EJE) were placed directly on the thrust measuring device itself to measure thrust. This was possible due to EJE models developed a relatively low weight and compactness so far, as well as there was possibility of creating a flexible current joins and gas supply lines system from bench equipment to the engine located on the thrust measuring device. Unfortunately, the BPRD-100 design does not allow following this standard path due to the large weight and large dimensions engine, as well as the rigidity communications system from the bench equipment to the engine. Therefore, in this paper, we considered the possibility to determining the thrust of the BPRD-100 using locally measured parameters of the plasma jet flowing from the engine, such as ion energy, ion current density, etc., for the measurement of which an appropriate diagnostic complex was developed.

The complex included: a thrust-measuring device developed according to the torsional scales scheme with a system of feedbacks, various types of measuring probes (single electrostatic Langmuir probes, multi-cell probes), electrical measuring instruments, dynamic type mass spectrometer МХ-7304, oscillography, computer equipment, as well as a mechanical devices system for moving and fixing the probe position relative to the plasma jet engine, etc. Available at the test bench a SPT-100 stationary plasma engine small model was used to create a plasma jet. The SPT-100 engine was mounting on a thrust measuring device, and the thrust was measured when the running engine using different working gases (Ar, Kr, Xe) in a wide range parameter. Simultaneously, the parameters of the plasma jet flowing from the engine were measured with the thrust measurement. The ion current distributions over the beam cross section, the ions energy spectra, a existence and a number multiply charged ions etc. were defined. Further, based on the obtained data, the thrust values F were calculated for several operating modes of the SPT-100 engine according to the following empirical relationship: F = 1.13\*(√(M\*Ei)/e)\*Ii\*(n+ + n2+\*√2).

Here M and Ei are the mass and average energy singly charged ions working gases, Ii is the magnitude the ion current, n+, n2+ are the fractions singly and doubly charged ions working gases in the engine plasma jet.

The difference between the thrust values obtained using the thrust measuring device and those calculated on the basis measured parameters plasma jet is within ±10%. This result is confirmed by the test data SPT-100 model on different gases in a wide range of discharge voltages and working gas supplies. Therefore, the approach considered above seems to be quite reasonable for determining the thrust based on the measured parameters plasma jet, at least at the initial stage of testing the prototype BPRD-100 engine. Furthermore, it is essential that the measured parameters plasma jet allow us to judge the processes of plasma formation and its acceleration in the engine working chamber and look for opportunities to optimize these processes and accordingly the engine itself.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Pt/ru/HD-Veselovzorov.docx) [↑](#footnote-ref-1)