

Experimental investigation of functioning of cylindrical phase separators found in spacecraft capillary fluid drainage systems subjected to external fluid flow

© A.V. Novikov, E.A. Andreev

Bauman Moscow State Technical University, Moscow, 105005, Russia

The article deals with experimental studies of how capillary fluid drainage systems (CFDS) of fuel tanks function when the liquid fuel component flows around their phase separators. We present a theoretical model describing this process. Based on the analysis conducted, we used a flow loop facility to simulate actual operation conditions, for example, the liquid component motion over the fuel tank volume creating extra dynamic load on the CFDS. Comparative analysis of experimental data and previously obtained theoretical investigation results concerning the process of the liquid component flowing around the cylindrical phase separator grates showed good convergence of results.

Keywords: spacecraft, capillary fluid drainage systems, simulated service testing, flow loop facility, phase separators

REFERENCES

- [1] Bagrov V.V., Kurpatenkov A.V., Polyayev V.M., Sintsov A.L., Sukhostavets V.F. *Kapillyarnye sistemy otbora zhidkosti iz bakov kosmicheskikh letatelnykh apparatov* [Capillary fluid drainage systems for spacecraft tanks]. Polyayev V.M., ed. Moscow, UNPTs Energomash [Research, Education and Manufacturing Centre of Power Engineering] Publ., 1997.
- [2] Petrazhitskiy G.B., Sukhostavets V.F., Novikov A.V. *Izvestiya vysshikh uchebnykh zavedeniy. Mashinostroenie — Proceedings of Higher Educational Institutions. Machine Building*, 1990, no. 5, pp. 46–50.
- [3] Goncharov D.A., Pozhalostin A.A., Kokushkin V.V. *Nauka i obrazovanie: nauchnoe izdanie MGTU im. N.E. Baumana — Science and Education: Scientific Edition of Bauman MSTU*, 2015, no. 4. DOI: 10.7463/0415.0763626
- [4] Kudryavtsev V.M. *Osnovy teorii i rascheta zhidkostnykh raketnykh dvigateley* [Foundations of liquid rocket engine theory and parameter calculation]. Moscow, Vysshaya Shkola Publ., 1993.
- [5] Aleksandrov A.A., Khartov V.V., Novikov Yu.M., Krylov V.I., Yagodnikov D.A. *Vestnik MGTU im. N.E. Baumana. Ser. Mashinostroenie — Herald of the Bauman Moscow State Technical University. Series Mechanical Engineering*, 2015, no. 6 (105), pp. 130–142.
- [6] Novikov A.E., Resh G. F., Ivanov M. Yu. *Nauka i obrazovanie: nauchnoe izdanie MGTU im. N.E. Baumana — Science and Education: Scientific Edition of Bauman MSTU*, 2013, no. 2. DOI: 10.7463/0213.0533503
- [7] Goncharov D.A., Pozhalostin A.V., Kokushkin V.V. *Nauka i obrazovanie: nauchnoe izdanie MGTU im. N.E. Baumana — Science and Education: Scientific Edition of Bauman MSTU*, 2015, no. 6. DOI: 10.7463/0615.0779724
- [8] Novikov A.V., Sukhov A.V., Andreev E.A. *Inzhenernyy zhurnal: nauka i innovatsii — Engineering Journal: Science and Innovation*, 2017, iss. 1 (61). DOI: 10.18698/2308-6033-2017-1-1576

- [9] Goncharov D.A. *Nauka i obrazovanie: nauchnoe izdanie MGTU im. N.E. Baumana — Science and Education: Scientific Edition of Bauman MSTU*, 2012, no. 4. DOI: 77-30569/362856
- [10] Aleksandrov L.G., Kuzmin O.A., Makarov V.P. *Vestnik NPO im. S.A. Lavochkina (Herald of the Lavochkin Science and Production Association)*, 2014, no. 1, pp. 47–49.
- [11] Asyushkin V.A., Vikulenkov V.P., Ishin S.V. *Vestnik NPO im. S.A. Lavochkina (Herald of the Lavochkin Science and Production Association)*, 2014, no. 1, pp. 3–9.
- [12] Novikov Yu.M., Bolshakov V.A., Partola I.S. *Izvestiya vysshikh uchebnykh zavedeniy. Mashinostroenie — Proceedings of Higher Educational Institutions. Machine Building*, 2015, no. 11 (668), pp. 106–113.
- [13] Sapozhnikov V.B., Krylov V.I., Novikov Yu.M., Yagodnikov D.A. *Inzhenernyy zhurnal: nauka i innovatsii — Engineering Journal: Science and Innovation*, 2013, iss. 4. DOI: 10.18698/2308-6033-2013-4-707
- [14] Armour J.C., Cannon J.N. *AIChE J.*, 1968, vol. 14, no. 3, pp. 415–420.

Novikov A.V., Cand. Sc. (Eng.), Assoc. Professor, Department of Rocket Engines, Bauman Moscow State Technical University. Author of over 20 scientific publications in the field of experimental and theoretical studies of gas and fluid flows in structurally complex media. e-mail: kafedra-e1@yandex.ru

Andreev E.A., Cand. Sc. (Eng.), Assoc. Professor, Department of Rocket Engines, Bauman Moscow State Technical University. Author of over 30 scientific publications in the field of two-phase flows in rocket engine gas paths and diagnostic methodology for rocket and jet engine work cycles. e-mail: kafedra-e1@yandex.ru