
Estimated accuracy of the analysis of convective heat transfer at the critical point of the sphere based on the research results

© Gorskiy V.V.^{1,2}, Olenicheva A.A.^{1,2}

¹JSC "MIC "NPO Mashinostroyenia", Moscow region, Reutov-town, 143966, Russia

²Bauman Moscow State Technical University, Moscow, 105005, Russia

The paper presents the results of systematic analysis of convective heat transfer and friction at the critical point of the sphere on the basis of the numerical solution of boundary layer equations. It is found that the error in known formulae is significantly higher than indicated in the literature. The system of relations characterized by an increased accuracy in the calculation of heat transfer and friction is offered.

Key words: heat transfer, critical point, numerical methods, boundary layer

REFERENCES

- [1] Predvoditelev A.S., Stupochenko E.V., Pleshanov A.S. *Tablitsy termodinamicheskikh funktsiy vozdukha (dlya temperatury ot 200 do 6000 K i davleniya ot 0,00001 do 100 atm.)* [Tables of Air Thermodynamic Functions (for Temperatures between 200 and 6000 K and Pressures from 0.00001 to 100 atm.)]. Moscow, Vychislitelnyi Tsentr AN SSSR Publ., 1962, 268 p.
- [2] Gorskiy V.V., Fedorov S.N. *Inzhenerno-Fizicheskii Zhurnal – Journal of Engineering Thermophysics*, 2007, vol. 80, no. 5, pp. 97–101.
- [3] Gorskiy V.V. *Zhurnal vychislitelnoy matematiki i vychislitelnoy fiziki RAN – Journal of Computational Mathematics and Computational Physics RAS*, 2007, vol. 47, no. 6, pp. 939–943.
- [4] Rouz P., Stark W. Izmereniya teploobmena v lobovoy tochke v dissotsiirovannom vozdukhe [Measurements of Heat Transfer in the Stagnation Point in Dissociated Air]. In: *Problemy dvizheniya golovnoy chasti raket dalnego deistviya* [Problems of Long Haul Missile Head Movement]. Moscow, Inostrannaya Literatura Publ., 1959, p. 277. [in Russian].
- [5] Zemlyanskiy B.A., Lunev V.V., Vlasov V.I., et al. *Rukovodstvo dlya konstruktorov. Konvektivnyi obmen izdelyi RKT* [Design guide. Convective Heat Transfer in Rocketry Products]. Korolev, TsNIImash Publ., 2010.
- [6] Aoki M. *Vvedenie v metody optimizatsii. Osnovy i prilozheniya nelineynogo programmirovaniya* [Introduction to Optimization Techniques. Fundamentals and Applications of Nonlinear Programming]. Moscow, Nauka Publ., 1977. [in Russian].
- [7] Vatolina E.G., Gorskiy V.V., Gorskaya N.A., Olenicheva A.A. *Inzhenerno-Fizicheskii Zhurnal – Journal of Engineering Thermophysics*, 2011, vol. 84, no. 2, p. 348.
- [8] Fey J. A., Riddel F.K. Teoreticheskiy analiz teploobmena v lobovoy tochke, omyvaemoy dissotsiirovannym vozdukhom [Theoretical Analysis of Heat Transfer in the Stagnation Point Washed by Dissociated Air]. In: *Problemy dvizheniya golovnoy chasti raket dalnego deistviya* [Problems of Long Haul Missile Head Movement]. Moscow, Inostrannaya Literatura Publ., 1959, p. 217. [in Russian].

-
- [9] Sinchenko S.G. *Zhurnal vychislitelnoy matematiki i vychislitelnoy fiziki – Journal of Computational Mathematics and Computational Physics*, 1968, vol. 8, no. 4, p. 917.
 - [10] Paskonov V.M., Polezhaev Yu.V., Nestatsionarnoe plavlenie vyazkogo materiala v okrestnosti tochki tormozheniya. *Chislennye metody v gazovoy dinamike. Sbornik rabot vychislitelnogo tsentra MGU* [Unsteady Melting Viscous Material in the Vicinity of the Stagnation Point. Numerical methods in Gas Dynamics. Collected Works of Moscow State University Computing Center]. Roslyakov G.S., Chudov L.A., eds. Moscow, MGU Publ., 1963, pp. 123–134.

Gorskiy V.V. (b.1939) graduated from Moscow Aviation Institute named after Sergo Ordzhonikidze in 1963. Senior staff scientist at the JSC (open joint-stock company) "MIC "NPO Mashinostroyenia". Dr. Sci. (Eng.), Professor of the Department "Computational Mathematics and Mathematical Physics" at Bauman Moscow State Technical University. Author of more than 133 publications. Scientific interests: heat and mass transfer, ablation heat protection, high temperature heat-mass transfer, numerical methods of solving equations of mathematical physics. e-mail: gorsk nat@yandex.ru

Olenicheva A.A. (b. 1979) graduated from Moscow Power Engineering Institute in 2002. Senior Scientist at the JSC (open joint-stock company) "MIC "NPO Mashinostroyenia". Author of 10 publications. Scientific interests: heat and mass transfer.