COMMENTS ON THE PAPER BY I. T. SHVETS AND E. P. DYBAN* "HEAT TRANSFER DURING CONTACT OF PLANE METALLIC SURFACES"

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In their paper Shvets and Dyban examined the transmission of heat during contact of two plane metallic surfaces. The authors gave their main attention to a possible basis for establishing generalized relations, and in this they showed that in the papers of other authors until now the results of experiments have been processed in the form of individual relations of the type**

$$\alpha = f(p_{sp}).$$

From theoretical considerations, the authors of the paper obtained the equation

$$\mathrm{Nu}_K = 1 + \frac{2}{\pi}\frac{\lambda_{nom}}{\lambda_m}\eta, \qquad (1)$$

which they recommend for calculations of contact heat transfer at specific pressures below $500 \cdot 9.81 \cdot 10^4$ N/m^2. The authors further state that, if the variation of the area in direct contact is connected by a power law with the specific pressure, then this relation may be considered as a parametric equation of the type

$$\mathrm{Nu}_K = 1 + C(p/\sigma)^n.$$

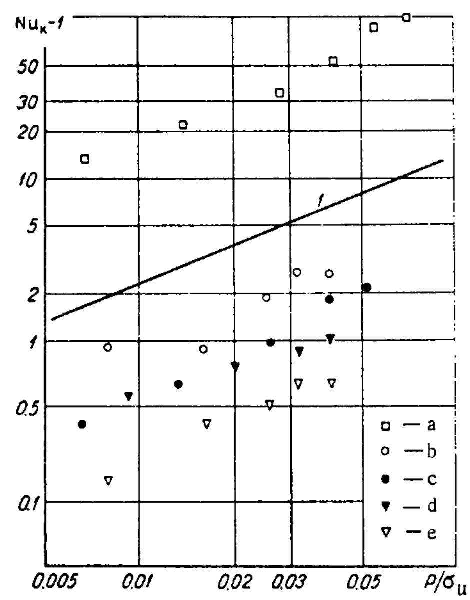
In conclusion the authors present a summary graph showing the known experimental data on contact heat transfer, presented in the form $\mathrm{Nu}_K = f(p/\sigma)$, and derive from these the approximation

$$\mathrm{Nu}_K = 1 + 85(p/\sigma_u)^{0.8}. \qquad (2)$$

According to the authors' statement, the parametric equation mentioned may be used to determine values of thermal contact resistance for practically all metals used in power plant and mechanical engineering. The authors stress that the relation given may also be used to calculate heat transmission through a contact located in a very high vacuum.

Thus, if their statement is to be believed, a universal parametric relation has been found which is well supported by a large number of experimental data, and is recommended for wide practical use.

Without going into the theoretical reasoning, which is not original, it should be noted that the authors obtained Eq. (1), in which there appeared, in addition to the quantity η describing the relative area of actual contact, the ratio of some nominal thermal conductivity of the surfaces in contact, $\lambda_{nom} = \lambda_1\lambda_2/(\lambda_1 + \lambda_2)$ to the thermal conductivity of the gas layer λ_m. In the authors' opinion, variation of the ratio λ_{nom}/λ_m, we have a constant coefficient, whose value is 85. Test data are included in the summary graph (see Fig. 2 in the paper by Shvets and Dyban) for such metals in contact as copper, brass, dural, and carbon and stainless steel, located in various media (air, carbon dioxide, hydrogen, and vacuum). It is not difficult to see that for the materials mentioned the ratio λ_{nom}/λ_m may vary roughly from 1000 for poorly conducting metals located in hydrogen, to infinitely large values, when the thermal conductivity of the medium becomes zero (i.e., for a high vacuum). Since the ratio λ_{nom}/λ_m does not appear in approximation (2), we must have the same value of contact heat transmission for different materials with different thermal-conductivity values if there is no change in (p/σ_u), λ_m and the cleanness of the surface, a fact which contradicts known experimental data.



Results of expressing the experimental data in the form proposed by Shvets and Dyban: 1) $\mathrm{Nu}_K = 1 + 85(p/\sigma_u)^{0.8}$; a) D-16 dural, 4th class of cleanness; b) 1X18H9T steel, 5th class of cleanness; c) steel 3, 8th class of cleanness; d) 1X18H9T steel, 5th class of cleanness; pressure 5 MN/m^2, different tempeature; e) 1X18H9T steel, 5th class of cleanness, in helium.

An attempt to reduce the experimental data of

*IFZH, no. 3, 1964.

**The conventional notation is retained.

Shlykov and Ganin* on contact heat transfer to the form proposed by Shvets and Dyban did not produce a positive result. The figure shows these data, and relation (2) has also been plotted. It may be seen that the discrepancy is more than ±1000%. It should be noted here that the vacuum points cannot in general be shown, since for them

$$\mathrm{Nu}_\kappa = (4/\pi)\, \alpha_c h_0/\lambda_m = \infty .$$

*Teploenergetika, no. 6, 1960.

In this context it is absolutely incomprehensible to assert that relation (2) "may be used to calculate heat transmission through a contact located in a high vacuum," since it is quite clear that in such a method of presentation of the experimental data, the heat transmission through a contact will be zero.

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