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Discussion

Discussion: ''Thermal Contact Resistance of Silicone Rubber to AISI 304 Contacts'' [ASME J. Heat Transfer, 121, pp. 700–702 (1999)][1]

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The authors are to be complimented on this interesting and informative paper. I have, however, the following comments.

1 Elastomers are time sensitive and continue to deform under load (room temperature creep). Because of this, the contact resistance may be expected to vary with time. Were any attempts made to investigate the time-dependence of the resistance?

2 The Results and Discussion section of the paper appears to indicate that the conductivity, k_r, of the silicone rubber is accurately known. The bulk resistance, R_b, then equals (t/k_r), where t is the thickness of the rubber. How does this compare with the measured value of R_b?

3 In Tables 1 and 2, the mean asperity slopes are expressed in terms of [μm/m]. This means that the slopes for the metal surfaces range from 0.143×10^{-6} to 0.427×10^{-6}. These values seem to be extremely small. Our experience with similar metallic surfaces indicates that the slopes are of the order of 0.2. I believe, therefore, that the slopes should have been expressed in terms of [μm/μm] and not [μm/m].

4 In the second to last paragraph of the paper it is said that: ''At the lower interface the heat flow is from metal to elastomer . . . ''. This is incorrect. The heat flow is from elastomer to metal at the lower interface. (At the *upper* interface, the heat flow is from metal to elastomer, as correctly stated in the paper.)

I would appreciate the authors' response to the above remarks.

[1]Parihar, S. K., and Wright, N. T., 1999, ''Thermal Contact Resistance of Silicone Rubber to AISI 304 Contacts,'' ASME JOURNAL OF HEAT TRANSFER, Vol. 121, pp. 700–702.

Closure to ''Discussion of 'Thermal Contact Resistance of Silicone Rubber to AISI 304 Contacts' '' [ASME J. Heat Transfer, 122, p. 403 (2000)]

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We appreciate Professor Madhusudana's careful reading of our paper and value his comments. Our response to his concerns follows.

1 Time Dependence of Resistance. During tests of more than 40 hours at constant mechanical load (0.1214 MPa) and heater power (3.2 kW/m^2), the resistances varied by less than $\pm$2.5 percent after reaching steady state. There was no trend, either increasing or decreasing, in the values of the resistances. Surface profiles of the contacting surfaces were measured before and after the test and, as shown in Table 2 of [1], no significant difference was found in the surface profiles of the specimen. This indicates that, within the range of temperatures and mechanical loads tested, no significant changes in the surface characteristics occur during the duration of the test.

2 Bulk Resistance. The thermal conductivity of the elastomer under investigation was measured before conducting the thermal contact resistance tests. Assuming a linear temperature distribution between adjacent thermocouples in an elastomer specimen, the thermal conductivity for the range of temperatures and mechanical loads to be tested was calculated using Fourier's equation. The thermal conductivity of the elastomer is temperature-dependent, so care must be taken in calculating the bulk resistance from the thickness and thermal conductivity. Nevertheless, the bulk resistances calculated from the thickness and the measured thermal conductivity values agree well ($\pm$5 percent) with the bulk resistance obtained by subtracting the sum of the measured interface resistances from the total resistance of the joint. The details may be found in Parihar [2].

3 Asperity Slope. You are right, the units in Table 1 and 2 should read μm/μm.

4 Heat Flow Direction. Yes, at the lower interface the heat flow is from elastomer to metal.

Reference

[1] Parihar, S. K., and Wright, N. T., 1999, ''Thermal Contact Resistance of Silicone Rubber to AISI 304 Contacts,'' ASME J. Heat Transfer, **121**, pp. 700–702.
[2] Parihar, S. K., 1997, ''Thermal Contact Resistance of Elastomer to Metal Contacts,'' Ph.D. dissertation, University of Maryland, Baltimore, MD.

