# Thermomechanical Transients at the Contact of a Steel Sphere Sliding against an Insulating Plane. Part 1: Thermoelastic Conditions

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## 1. Introduction

In this paper we study initially circular point contacts and their evolution during sliding with friction for the thermoelastic case.

## 2. Numerical simulations

We are able to match the overall shrinking of the contact with time to an approximate analytical solution due to Barber (1980) as shown in Fig 1.

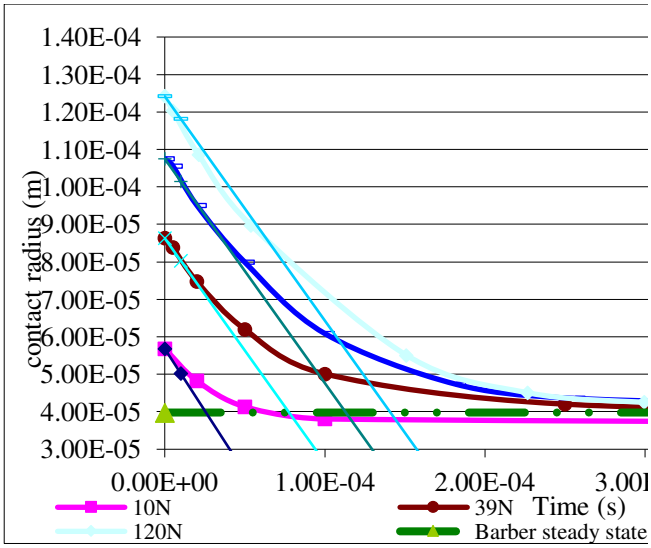


Fig 1. Change of contact radius versus time at different loads (heavy lines) compared with Barber's (1980) analysis. f = 0.6 V = 2.6 m/s Radius = 5 mm

We consider this to be a good calibration of the numerical simulation. The Barber analysis assumes symmetric pressure and temperature distributions. In the simulation, we find temperatures and contact areas are in close agreement with the Barber analysis while some features, e.g. a location and shape of pressure and temperature maxima away from the center to the front of the contact, that are different. One example of the shift of the size, shape and location of the contact from initial to steady state is shown in Fig 2.
It is also worth noting that the analytical solution only seems to be applicable to rather extreme conditions of thermal input, inconsistent with elastic behavior

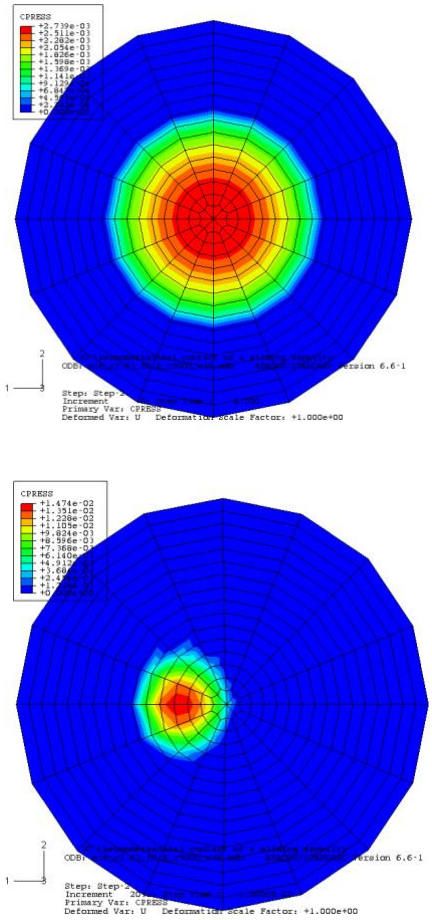


Fig 2. Initial and final pressure distributions.

## 3. Conclusions

The numerical simulations are in good agreement with the analysis of Barber, even though some differences are seen. Thermoelastic transients are very rapid ($10^6$ to $10^8$ $^o$C/sec for such macro-contacts).
In thermoelastic sliding, the high pressure and high temperature regions shift forward within the contact during sliding. When the initial contact size is at least 50 percent larger than the Barber steady state, our simulations duplicate his theoretical results in terms of instantaneous contact size.

## 4. References

[1]. Barber, J. R. (1980). "The Transient Thermoelastic Contact of a Sphere Sliding on a Plane," Wear, 59, 1980, 21-29.