



UNIVERSITY OF DAYTON  
DAYTON, OHIO 45469

SCHOOL OF ENGINEERING  
DEPARTMENT OF MECHANICAL ENGINEERING

September 29, 1976

Dr. William Weigand  
Energy, Chemistry and Energetics Section  
1800 G. Street, N. W.  
Washington, D. C. 20550

SUBJECT: Proposal No. R-2419 entitled "Experimental Determination of  
Thermodynamic Equilibrium Diagrams for Lubricants".  
NSF Proposal Eng. -7604343

Dear Dr. Weigand:

I am writing in response to our telephone conversation of Sept. 17. The three items you inquired about were 1. approach to be used if the chemical structure is altered due to high pressure, 2. availability of pyrolysis gas chromatography equipment and 3. indication of energy savings potential.

1. Structural Changes

Our proposal seeks to determine the static, equilibrium states of synthetic lubricants over a pressure range to 500,000 psi and temperature to 160°F as well as to identify the precise phases existing at the various states. Since the proposed research has never been completed on lubricants to these levels, the extent of structural changes, if any, is at this stage unknown. However, should we experience a major alteration of the chemical structure of the lubricants in the tests the phase diagram will be established to that level of pressure and temperature. These structural changes, as well as any subsequent structural changes to the proposed test levels, will be carefully documented and studied. Further, glass transition states, should they occur, will be established as discussed in the proposal.

2. Equipment Availability

The pyrolysis gas chromatography equipment referred to on page 6-2 of our proposal is available in our laboratories for our use in the proposed research.

3. Indication of Energy Savings

As a result of our proposed research it will be possible to design to increase fatigue life and to reduce friction and wear. Ball and roller bearings, gears and cams are widely used

in virtually all machine applications throughout the United States. A brief discussion of potential energy savings, based on studies completed in the United Kingdom, is enclosed for your reference.

Thank you for giving me the opportunity to elaborate on these questions. Should you need any other information please don't hesitate to contact me.

Very truly yours,

John N. Crisp  
Associate Professor

JNC:cr

Enclosure

INDICATION OF POTENTIAL SAVINGS OF ENERGY

Peter Jost<sup>(1)</sup> indicates that through proper application of tribology principles (the science and technology of interactive surfaces in relative motion), the economic savings could amount to as much as \$16 billion per year in the United States. His estimate is based on studies in the United Kingdom in 1965 which estimated a savings of \$48 million in that country due to reductions in energy consumption through lower friction alone. The same studies estimate an aggregate savings of \$1.266 billion for all British industry through proper application of tribology principles. A breakdown of the savings is summarized in Table I. The magnitude of the potential savings is rather evident.

TABLE I<sup>†</sup>

POTENTIAL TRIBOLOGY BENEFITS IN THE UNITED KINGDOM	
	\$ MILLION
Reduction in lower energy consumption through lower friction	48
Reduction in manpower	24
Savings in lubricant costs	24
Savings in maintenance and replacement costs	552
Savings of losses consequential upon breakdowns	276
Savings in investment due to higher utilization and greater mechanical efficiency of machinery	52
Savings in investment through increased life of machinery	290
1965 Totals (Published in 1966)	1,266

† Jost, P. H., "Economic Impact of Tribology", Mechanical Engineering, August 1975, PP. 26-33.