

FRICION AND WEAR TRANSITIONS OF MATERIALS:

Break-in, Run-in, and Wear-in
by Peter J. Blau

REVIEWED BY RANGA KOMANDURI¹

Friction and Wear Transitions of Materials: Break-in, Run-in, Wear-in by Peter J. Blau is a new addition to the literature on tribology. For those readers who are not familiar with the term tribology, it deals with the problems associated with interacting surfaces in relative motion, and all related practices. In practical terms, tribology deals with a class of problems involving friction, lubrication, and wear. This book differs from others in that it concentrates on a niche area, namely, transitions in friction and wear of materials instead of steady state conditions. The author identifies in the Preface that the subject of transitions in friction and wear is not widely documented in the western literature. The book is intended to address this area. The author also points out in Chapter 1 that the book is meant to be neither an all-encompassing treatise on tribology nor a 'how-to' handbook for solving specific component wear problems. The book, according to this reviewer, can also serve as a source book on who and where specific work on tribology has been authored and published in the literature.

The 476 page book contains the following eight chapters and two appendices.

- Chapter 1. Tribology and its Nomenclature
2. Friction: Basic Property or System Characteristic?
3. The Classification of Wear Modes
4. Transition Processes in Tribology
5. Break-in, Run-in, and Wear-in
6. A Semi-empirical Model for Sliding Friction and Wear Transitions
7. Control of Tribological Transitions, and
8. Summary

Appendix I. Microindentation Testing Equations

- II. Bibliography of selected articles concerning run-in from the Soviet Journal of Friction & Wear

In addition, the book contains definitions of various tribological terms, a materials index, and a subject index. The chapters, in general, also contain a reasonably extensive list of references.

Chapter 1 gives a general introduction to tribology and its terminology. The interdisciplinary nature of tribology is well emphasized. Names of journals and databases related to tribology are also given.

Chapter 2 discusses friction as a system characteristic and points out that friction coefficient is not a basic property. Measurement and methods of determining friction force and friction coefficient are outlined together with the problems associated with the use of oscillatory sliders whose friction force sensors are not collinear with the friction force vectors

or those situations where slider contact position changes as the fixture deflects in measuring friction force. A format developed by Czichos for reporting friction coefficient test data is also included and described. A list of references dealing with reviews of friction theories is also given.

Chapter 3, by far the longest chapter of the book, summarizes various wear modes including abrasion, cavitation, chemical and oxidation wear, erosion, fatigue wear, fretting, and sliding wear as well as combined wear modes. Each section also includes a table which lists details of more extended reviews on wear modes published in the literature. A section dealing with practical consideration in wear testing and the development of wear testing standards is also included.

Chapter 4 addresses the subject of tribological transitions which are classified into two broad classes, namely natural and induced. The effects of 'third-body' and surface films including interfacial transfer on friction and wear transitions are also considered. Transition in tribosystems where surface-modified or coated materials involved are also discussed.

Chapter 5 deals with a kind of transition that is associated with early stages of sliding wear, namely, break-in, run-in, and wear-in. The chapter begins with definitions of these terms followed by shapes and other attributes of friction break-in curves which are classified by shape, duration, and variability. The effect of surface roughness, lubrication, and microstructural factors on break-in, run-in, and wear-in are then discussed. The chapter ends with industrial run-in practices which are often connected with surface finish and geometric conformation. Since run-in condition differs from one application to another other criteria such as specified steady state friction coefficient level, uniform surface film thickness, steady state operating temperature, or obtaining a linear wear rate may be applied.

Chapter 6 presents a semi-empirical model for sliding friction and wear transition based on a model developed by the author. The model is based on the shape, duration, and variability of friction coefficient with time as discussed in Chapter 5. The effect of lubrication, initial break-in, and longer term transitions are then discussed.

Chapter 7 deals with control of tribological (friction and wear) transitions. This involves anticipation, the potential form transition, prediction of the most likely type, and adjustment of tribosystem parameters to alter or suppress the transitions. The chapter ends with the introduction of the concept of tribo communication, namely, the process that promotes the spread of wear damage along a contact surface of a tribosystem.

Chapter 8 summarizes the highlights of the preceding chapters.

A minor comment to the attention of the publishers on the setup of the book. While computers are very useful for the preparation of the manuscripts and in the containment of costs, this reviewer would like to see better quality line diagrams than some of them presented in the book.

The book is recommended as a reference book to engineers (practicing or conducting research on tribology) or to libraries in the institutions where tribology work is conducted. It is also recommended for those "hapless engineers" as the author rightly pointed out in the Preface, who with no prior warning have been designated the company's friction and wear experts.

¹Mechanical and Aerospace Engg, Oklahoma State University Stillwater, OK 74073. Formerly Directorate of Engineering, National Science Foundation, Washington, D.C. 20550.