

# **Friction, Lubrication, and Wear Technology**

## **1. Solid Friction**

Introduction to Friction

Basic Theory of Solid Friction

Frictional Heating Calculations

Laboratory Testing Methods for Solid Friction

Friction during Metal Forming

Appendix: Static and Kinetic Friction Coefficients for Selected Materials

## **2. Lubricants and Lubrication**

Introduction to Lubrication

Liquid Lubricants

Lubrication Regimes

Lubricant Additives and Their Functions

Solid Lubricants

Grease

Lubricants for Rolling-Element Bearings

Metalworking Lubricants

Lubricants for High-Vacuum Applications

Internal Combustion Engine Lubricants

## **3. Wear**

Introduction to Wear

Surface Damage

Abrasive Wear

Polishing Wear

Solid Particle Erosion

Cavitation Erosion

Liquid Impingement Erosion

Slurry Erosion

Sliding and Adhesive Wear

Fretting Wear

Rolling Contact Wear

Impact Wear

Corrosive Wear

Oxidational Wear

Surface Examination  
Vibration Analysis  
Lubricant Analysis  
Motor-Current Signature Analysis  
Radionuclide Methods

#### **4. Laboratory Characterization Techniques**

Introduction to Laboratory Characterization Techniques  
Surface Texture  
Surface Topography and Image Analysis (Area)  
Confocal Microscopy  
Wear Measurement  
Light Microscopy  
Electron Microscopy  
Scanning Tunneling Microscopy  
Measurement of Surface Forces and Adhesion  
Characterization of Surfaces by Acoustic Imaging Techniques  
Microindentation Hardness Testing  
Nanoindentation  
Scratch Testing  
Surface Temperature Measurement  
Surface Chemical Analysis  
X-Ray Characterization of Surface Wear

#### **5. Systematic Diagnosis of Friction and Wear Test**

##### **Data**

Basic Tribological Parameters  
Design of Friction and Wear Experiments  
Presentation of Friction and Wear Data  
Concepts of Reliability and Wear: Failure Modes

#### **6. Friction and Wear of Components**

Friction and Wear of Rolling-Element Bearings  
Friction and Wear of Sliding Bearings  
Friction and Wear of Gas-Lubricated Bearings  
Friction, Lubrication, and Wear of Gears  
Friction and Wear of Seals  
Friction and Wear of Internal Combustion Engine Parts  
Friction and Wear of Automotive and Truck Drive Trains  
Friction and Wear of Automotive Brakes  
Friction and Wear of Tires

Friction and Wear of Aircraft Brakes  
Wear of Jet Engine Components  
Wear of Pumps  
Friction and Wear of Compressors  
Friction and Wear of Cutting Tools and Cutting Tool Materials  
Friction and Wear of Dies and Die Materials  
Friction and Wear in the Mining and Mineral Industries  
Friction and Wear of Medical Implants and Prosthetic Devices  
Friction and Wear of Dental Materials  
Friction and Wear of Electrical Contacts  
Friction and Wear of Semiconductors

## **7. Materials for Friction and Wear Applications**

Introduction to Materials for Friction and Wear Applications  
Friction and Wear of Cast Irons  
Friction and Wear of Carbon and Alloy Steels  
Wear of Stainless Steels  
Friction and Wear of Bearing Steels  
Friction and Wear of Tool Steels  
Friction and Wear of Sliding Bearing Materials  
Friction and Wear of Hardfacing Alloys  
Friction and Wear of Cobalt-Base Wrought Alloys  
Friction and Wear of Ordered Intermetallic Alloys of Ni<sub>3</sub>Al  
Friction and Wear of Titanium Alloys  
Friction and Wear of Aluminum-Silicon Alloys  
Friction and Wear of Cemented Carbides  
Friction and Wear of Metal-Matrix Composites  
Friction and Wear of Ceramics  
Friction and Wear of Carbon-Graphite Materials  
Friction and Wear of Thermoplastic Composites

## **8. Surface Treatments and Coatings for Friction and Wear Control**

Thermal Spray Coatings  
Electroplated Coatings  
PVD and CVD Coatings  
Ion Implantation  
Laser Surface Processing  
Carburizing  
Nitriding and Nitrocarburizing