Chapter 3
Classification of Surface Constructs

ABSTRACT

This chapter discusses routes for the classification of surfaces and the evolution of surface metrology. There are two basic ingredients to the surface of a manufactured workpiece: the manufacturing process and the production technique. Each of the ingredients has an effect on the functionality of a rubbing part. The material provides an answering scheme for a question that often arises about how to characterize the influence of roughness features and how to utilize characterization metrics to predict, then monitor, performance.

INTRODUCTION

The layer encompassing the roughness layout of the surface (i.e. the asperities) undergoes intense changes during friction. The action starts at the inception of contact between the two mating bodies. When two surfaces approach each other (figure 1-a), the asperities are the first parts of the surface layer to experience the influence of the operation environment (load, speed, etc.). Further, the evolution of the contact process, and the behavior of materials thereafter, will depend to a great extent on the geometry, distribution and properties of the experience.

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Upon compliance, the asperities within the surface layers will deform to support the acting normal nominal load (figure 1-b). Because the asperities of a solid are not generally of the same length, or size, only the highest asperities will initially establish contact with like asperities within the counter body, to support the nominal load. However, because the initial true contact stress would be higher than the yield strength of the solid severe deformation will take place. The initial group of contacting asperities will be compressed relative to the stress acting on them. Compression will bring more asperities, those of lesser height, into contact to support the load. The new wave of asperities, in turn, will continue to undergo compression which will bring more asperities into contact. The compression-deformation process continues until the nominal load is fully supported. The initial engagement of asperities also implies that the only parts of the surface that establish contact are those parts supporting the load on the micro-level. This renders the true area of contact, that which is influential to the evolution of the friction process, only a small fraction of the joint apparent area between the two complying bodies.

Figure 1. Scenario of contact of real surfaces. Initially, the separation gap between the surfaces will diminish in proportion to the nominal normal load FN. The highest asperities will establish contact. Depending on the value of the true contact stress more asperities may come into contact until the nominal load is supported.